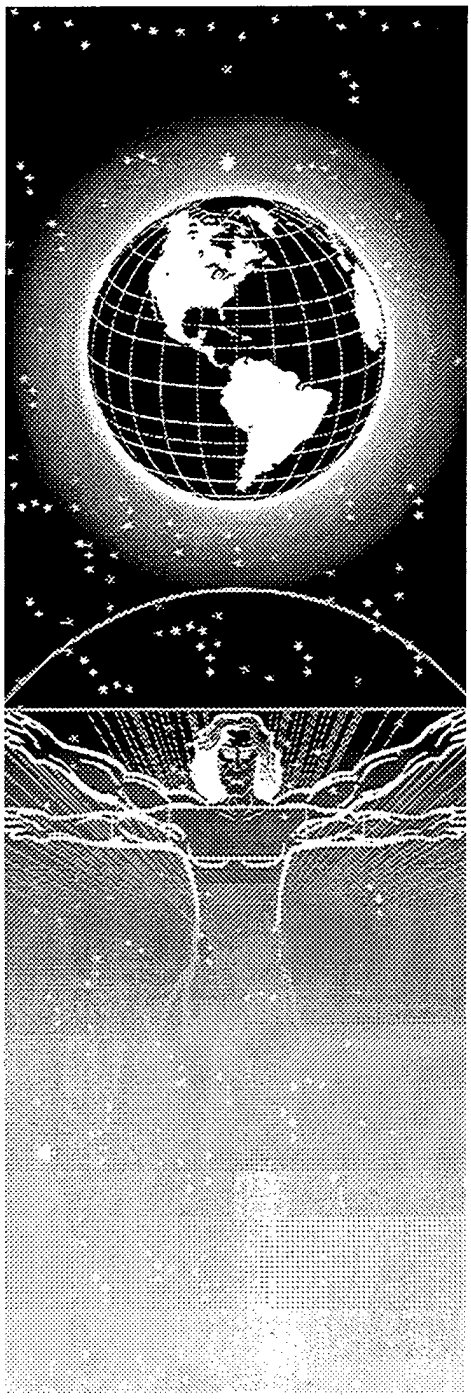
AL/HR-TP-1997-0047



UNITED STATES AIR FORCE
ARMSTRONG LABORATORY

Support Equipment Evaluation/Improvement Techniques (SEE/IT) Final Report

Bruce Cordes
Terry Gaumer
Skip Rohr
Cathy Sanchez
Fred Witham
Steve Zezuto

Northrup Grumman Corporation
Advanced Systems and Technology
8900 East Washington Blvd
Pico Rivera, CA 90660-3737

HUMAN RESOURCES DIRECTORATE
Logistics Research Division
2698 G Street
Wright-Patterson Air Force Base, Ohio 45433 7604

October 1997

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Human Resources Directorate
Logistics Research Division
2698 G Street
Wright-Patterson AFB OH
45433-7604

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This paper has been reviewed and is approved for publication.

DWIGHT F. PAVEK, CAPT, USAF
Program Manager

LOUIS M. JOHNSON, LT COL, USAF
Acting Chief, Logistics Research Division

PREFACE

This document is the final report and summarizes the results of the Support Equipment Evaluation/Improvement Techniques (SEEIT) project, F41624-95-C-5002, funded by Armstrong Laboratory, Logistics Research Division, Wright-Patterson Air Force Base, Ohio 45433, under the technical direction of United States Air Force Captain Dwight Pavek. The prime contractor for SEEIT is Northrop Grumman Corporation, Pico Rivera California, the sub-contractor is Lear Astronics, Ontario, California.

REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	October 1997	Final - Aug 1995 to Sep 1997

4. TITLE AND SUBTITLE
Final Report for Support Equipment Evaluation/Improvement Techniques (SEE/IT)

5. FUNDING NUMBERS
C - F41624-95-C-5002
PE - 62202F
PR - 1710
TA - D3
WU - 01

6. AUTHOR(S)
Bruce Cordes Cathy Sanchez
Terry Gaumer Fred Witham
Skip Rohr Steve Zezuto

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Northrop Grumman Corporation
Advanced Systems and Technology
8900 E. Washington Blvd
Pico Rivera, CA 90660-3737

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Armstrong Laboratory
Logistics Research Division
2698 G Street
Wright-Patterson AFB OH 45433 7604

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
AL/HR-TP-1997-0047

11. SUPPLEMENTARY NOTES
Armstrong Laboratory Monitor: Capt Dwight Pavek AL/HRGA, DSN 785-9651

12a. DISTRIBUTION AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The objective of this effort was to develop, demonstrate, and document processes and technologies for improved reliability, maintainability, and deployability (RM&D) for support equipment (SE). The breakup of the Soviet Union, increases in regional threats characterized by Iraq and Libya, and civil wars in small, emerging countries have vastly altered our national security threats and subsequent requirements. The military mission has been altered from stopping one enemy with a large defense structure to responding to regional threats by smaller countries. This has vastly altered weapon system requirements and life cycles which, in turn, alters the requirements levied on the related support structures. To meet these requirements, existing SE must be evaluated and modified to improve the RM&D of the equipment and thereby enhancing the effectiveness of operational wings. This effort focused on improving a select subset of SE processes and technologies to remove or minimize the identified shortfalls.

14. SUBJECT TERMS
deployability RM&D
maintainability support equipment
reliability

15. NUMBER OF PAGES
335

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR

Contents

List of Figures

Abbreviations & Acronyms

ABS	Acrylonitrile Butadiene Styrene
ACC	Air Combat Command
AETC	Air Education and Training Command
AFB	Air Force Base
AFCTS	Automatic Flight Control Test Set
AFMC	Air Force Materiel Command
AFSC	Air Force Specialty Code
AGE	Aerospace Ground Equipment
AGE/SE	Aerospace Ground Equipment/Support Equipment
AIS	Avionics Intermediate Shop
APU	Auxiliary Power Unit
ARPA	Advanced Research Projects Agency
CAGE	Commercial and Government Entity
CE&D	Concept Exploration & Development
CER	Comprehensive Engineering Redesign
CFT	Conformal Fuel Tanks
CGB	Central Gear Box
CIP	Common Integrated Processor
COLORS	Contingency Operations Logistics Requirements
Comm	Commercial
CONUS	Continental United States
COTS	Commercial Off-The-Shelf
CSBPC	Control Stick Boost Pitch Computer
CSC	Computer Sciences Corporation
CSFDR	Crash Survivable Flight Data Recorder
CTK	Consolidated Tool Kit
DDU	Digital Display Unit
DSC	Developmental Sciences Center
DTIC	Defense Technology Information Center
ECM	Electronic Countermeasures
EHA	Electrohydrostatic Actuators
EU	Electronic Unit
Ftr	Fighter
GEC	General Electric Company
GOX	Gaseous Oxygen

Abbreviations & Acronyms

GPGS	Ground Power Generator Set
GSE	Ground Support Equipment
Hdwr	Hardware
IFF	Identification, Friend or Foe
IMA	Item Manager Action
JFS	Jet Fuel Starter
LANTIRN	Low Altitude Navigation and Targeting Infrared for Night
LOGFOR	Logistics Force Document (Materiel)
MAGSS	Multifunction Aircraft Ground Support System
MHU	Munitions Handling Unit
MLG	Main Landing Gear
MTS	Microwave Test Station
MLV/PLV	Memory Loader Verifier/Portable Loader Verifier
NIST	National Institute of Science and Technology
NSF	National Science Foundation
NSN	National Stock Number
OLE	Object Linking and Embedding
PAA	Primary Aircraft Authorization
PAO	Polyalphaolefin
PECS	Portable Environmental Control System
PIWG	Product Improvement Working Group
PMEL	Precision Measuring Equipment Laboratory
QFD	Quality Function Deployment
Rcvr	Receiver
SA-ALC	San Antonio Air Logistics Center
SE	Support Equipment
SEEIT	Support Equipment Evaluation & Improvement Techniques
TEMS	Turbine Engine Monitoring System (A-10)
T.O.	Technical Order
TRP	Technology Reinvestment Program
UALS	Universal Ammunition Loading System
URMS&D	Usability, Reliability, Maintainability, Supportability & Deployability
Wg	Wing
WPAFB	Wright-Patterson Air Force Base

Section 1.0
Executive Summary

1.1 Program Overview

The Support Equipment Evaluation / Improvement Techniques (SEEIT) contract was performed during the period of August 1995 to September 1997 by Northrop Grumman's Advanced Systems and Technology Organization and Lear Astronics' Developmental Sciences Center. The objective of this research and development contract was to identify techniques to improve the overall usability, reliability, maintainability, supportability, and deployability (URMS&D) of AGE/SE. Specifically, the study focused on determining the most likely candidates for modification and identifying new technologies to provide affordable improvements to AGE/SE URMS&D characteristics. Figure 1-1 illustrates the Northrop Grumman team's understanding of the current AGE/SE problems.

The Overlapping Problems

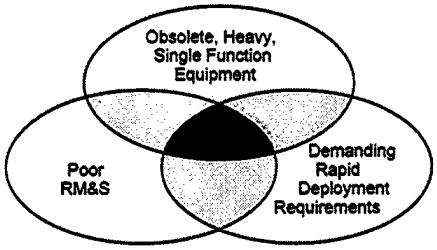


Figure 1-1. The Crux of the Support Equipment and Mobility Deficiencies

The study objectives were accomplished through four distinct tasks (Figure 1-2). Task 1 identified the AGE/SE problems, their root causes when known, and the criticality or consequences when they occur. Task 2 identified the technology/design solutions which have the potential to remedy the AGE/SE problems. Task 3 included a series of analyses and assessments to quantify the improvement factors and cost effectiveness of the solutions. The results of Task 4 identified the best combination and priority of solutions through a series of mini-Quality Function Deployment (QFD) iterations to align the most important requirements with the most effective solutions.

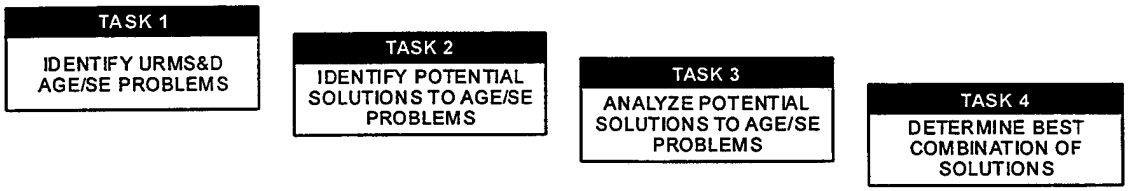


Figure 1-2. Building Block Approach to SEEIT Study Tasks

Scope

This study primarily encompasses the common flightline support equipment identified on a force deployment listing for a USAF fighter squadron. Additional support equipment items were studied if their impact on the weapons system's deployability characteristics or operational availability was felt to be fairly significant.

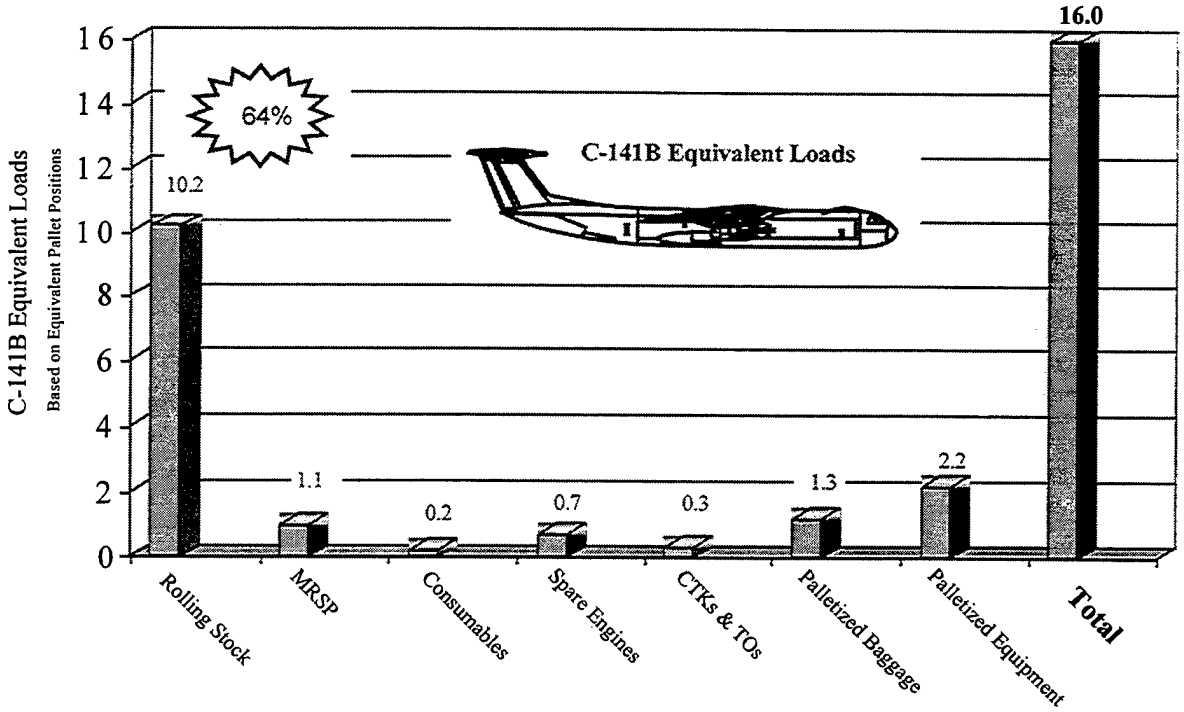


Figure 1-3. Mobility Airlift Requirements for an F-16 Squadron (18 PAA)

Another way to describe the scope of the SEEIT study is illustrated by Figure 1-3, above. The airlifter requirement is divided into 7 different categories for the force deployment package of an F-16 squadron.[1] As shown, rolling stock comprises 64 percent of the squadron's total airlifter requirement of 16 C-141B loads. The main equipment type evaluated by SEEIT was common flightline support equipment, which is primarily rolling stock. Figure 1-3 also shows that the main focus must be on rolling stock to reduce the deployment footprint of today's fighting forces. Figure 6-3 in section 6 presents a summary list of equipment evaluated in this study.

This study also examined a number of aircraft technologies which could be applicable to present day or future AGE/SE. Risk/Cost was a critical measure and was assessed in conjunction with the benefits achieved through modification, acquisition and/or consolidation of AGE/SE. The study findings should provide compelling rationale for follow-on technology demonstration initiatives and AGE/SE modification and replacement programs.

The results of each program task are briefly summarized below, and in greater detail in the remaining sections of this report. The following paragraphs highlight the accomplishments of the program.

[1] F-16C/D Squadron (18 PAA) LOGFOR with LANTIRN and Tank Buildup, 388th Ftr Wg, Hill AFB, UT, Sep 95.

Identify AGE/SE Problem Areas and Deficiencies (Task 1)
Prior to the first base visit to document SE problems, a comprehensive questionnaire was developed to facilitate the data collection process in the field. Since the interviews with support equipment users and maintainers would be the primary source of data, extra care was taken to ensure that the questionnaire familiarized the reader with the exact type of data being sought. The final version of the questionnaire was developed under a QFD process which included USAF participation. Lessons learned from the initial trips were incorporated in subsequent questionnaires which greatly enhanced the data collection efforts during the base visits.

The initial program plan scheduled one base visit per month. During Task 1, the team visited five different Air Force bases (Nellis, Mt. Home, Kelly, Luke, and Pope). The results of the field visits are discussed in Section 2.0, and each location's problem areas and deficiencies, along with severity factors, are included in tabular form as Appendix 1.

Over 1,400 separate problem areas were documented during these base visits. As experience was gained from the first few base visits, the SEEIT Team decided that the data needed to be managed by a highly capable, relational database. Our resident computer experts selected the Microsoft Access Database Management System software which is a very robust program that allows all forms of data to be stored and linked, including photographs. This automated database immediately became an indispensable tool in the collection, storage and easy manipulation of this large amount of raw data. Section 6.0 describes the development and use of the SEEIT database and the many different types of embedded controls and utilities that allow the user to represent and process the data in many useful ways.

Identify Potential Solutions (Task 2)
At the conclusion of Task 2, approximately 400 existing or near-term technologies were identified which appeared to offer promising solutions to many of the AGE/SE problems from Task 1. These solutions ran the spectrum from direct application of technologies and information systems, to changing current policies and procedures. This effort resulted in the preliminary identification of nearly 1,000 potential technology-to-equipment type pairings (see Figure 1-4) for subsequent assessment in Task 3. Some typical examples of the potential solutions identified are included in Appendix 2 and are further discussed in Section 3.0.

	Technology Match Found	No Technology Match Found	Totals
Problems	895	167	1,062
Comments Only	197	144	341
Totals	1,092	311	1,403

Figure 1-4. Summary of Potential Solutions to Problem Areas

After the technology-to-equipment type pairings were established, each of the effective technologies were further linked to the specific problem area or deficiency from Task 1 in the electronic SEEIT database. This permitted the development of several unique and comprehensive reports which were essential in performing the myriad of individual assessments required for Task 3.

Analyze and Assess Potential Solutions (Task 3)
The evaluation of potential technological solutions required a panel of knowledgeable personnel to assess the degree of improvement each technology might contribute to every equipment type and specific problem area to which it was linked. SEEIT Team personnel performing the assessments were comprised of AGE/SE users, maintainers, developers and personnel from the operational requirements and design-to-cost communities.

Each technology-to-equipment type pairing was assessed in seven key impact areas: Usability, Reliability, Maintainability, Supportability, Deployability, Safety, and Administrative. Each impact area score (0-10) was weighted by the highest problem severity factor within the respective impact area for that piece of equipment and then summed. The Risk/Cost associated with the implementation of a particular technology was assessed individually and scored with the aid of a matrix (0-100) which accommodated a very low risk/very low cost to very high risk/very high cost rating scheme. Section 4.0 provides an in-depth description of the Task 3 assessment process, the criteria used to supplement each assessment, the risk/cost matrix, and the rationale used for the assignment of problem area severity factors.

During the assessment process, many of the technology-to-equipment type pairings and problem area links were revisited and slightly revised, which reduced the number of individual assessments to 735. Each assessment, accompanied by the scoring rationale, can be easily reviewed in the SEEIT database. Additionally, Appendices 2 and 3, respectively, identify technologies with potentially high payoff and provide an overall technology rating summary.

Identify and Prioritize Best Combination of Solutions (Task 4)
As stated earlier, the Task 4 results identified the best combination of solutions through a series of mini-Quality Function Deployment (QFD) iterations. This was necessary to align the most important requirements with the most effective solutions. USAF participation on this task helped the SEEIT Team develop an integrated, analytic process which systematically and logically organized the information to improve the executive-level decision-making process.

Following a top-level review of the highest scoring technologies from the Task 3 assessments, the SEEIT Team collectively grouped and prioritized applicable technologies using two sharply varying perspectives. The first perspective addressed equipment problems that were awarded the highest severity factors without regard to the equipment's utilization frequency or criticality of its intended function. The second perspective focused on the most problematic equipment types which were identified by summing the severity factors of each equipment's unique problems and deficiencies collected during Task 1 (see Figure 1-5). As shown in Section 5.0, the majority of the severe equipment problems are not resolved by the implementation or insertion of

technologies. These problems are more aptly addressed by the prudent application of engineering redesign efforts or modification.

Power Generators
Auxiliary Lighting
Hydraulic Test Stands
Air Conditioners

Air Compressors

ID:	Technology	Score	Risk/Cost	Classifcation				
44	Low Cost Composite Advances	102	30-40	CP				
227	Heat and Fire Resistance Cable Covers	5	0-5			AP		
136	Lighter Weight Cast Iron Engine Blocks	53	75-80					ER
175	Multifunction Support Cart	160	25-25				UR	
159	Oil Resistant Silicone Seals	24	15-20		SP			
			Prioritization	3	2N	1		2F

LEGEND:	ER: Engines/Research	1 = 1ST Choice
CP: Composites/PIWG Action	UR: Unit Replacement/Research	N = Near Term
AP: Accessories/PIWG Action	SP: Seals/PIWG Action	F = Far Term

Figure 1-5. Technology Priority By Equipment Type (Example)

At the equipment level, general application of several of the more robust, cost effective technologies can provide significant improvements in overall system performance. Appendix 4 illustrates how these technologies have been logically grouped and prioritized by the SEEIT Team. Technologies that enhance AGE/SE deployability characteristics are also included in Appendix 4, followed by those technologies which impact environmental-related issues.

1.2 Summary of Findings

The results of the SEEIT study have produced some excellent findings, recommendations, and conclusions. Figure 1-6 identifies and briefly describes the major products included in this written report. The primary deliverable of this study, however, is the user-friendly, automated SEEIT database, which not only includes the data below, but has the capability to create numerous customized reports on demand. It also includes a wealth of supplemental data, such as SE specification data, individual problem severity factors, SE Lessons Learned, individual technology assessments, and aircraft R&M data. The SEEIT database was instrumental in keeping the program data well organized from Task 1 through Task 4, with the easy retrieval and sorting capabilities needed to achieve all of the original technical goals. The capabilities and unlimited growth potential of the automated SEEIT database will allow it to be a very valuable tool for future SE improvement and development efforts.

Appendix Title	Description of Contents
1: Problem Areas and Deficiencies	Listing includes over 1,400 field problems and comments collected during visits to the 5 bases. Entries are categorized by equipment type.
2: Technologies with High Payoff	Listing includes over 380 entries. Each entry has a short synopsis of the technology, source of the information and its potential application.
3: Technology Rating Summaries	Lists the impact score and risk/cost factor of each technology's ability to mitigate SE problems. Scoring adjusted by a problem severity factor.
4: Tech Priority By Eqpt Type	Listing prioritizes technologies for implementation for each equipment type. Classifies techs as research item, unit replacement, etc.
5: Tech Priority By Problem	Listing prioritizes technologies for implementation by specific problem. Classifies techs as research item, redesign effort or, item manager action
6: Programmatic Lessons Learned	A listing of problems and lessons learned by the SEEIT team during the performance of this study. Solutions are offered for future reference.
7: Force Deployment Summary	Listing summarizes the quantity of support equipment by type deployed for an 18PAA F-16C/D LANTIRN equipped squadron (first 30 days).

Figure 1-6. Summary Listing of SEEIT Results and Findings

The automated SEEIT database is a positive step forward in documenting and eventually resolving some of the larger problems with flightline SE (see Figure 1-7). It has the potential to serve as the collective data source needed by all other DoD agencies to solve these equipment deficiencies. The database, however, is only a start, and needs continuing contributions from other agencies to permit its expansion and usefulness as a comprehensive SE development tool.

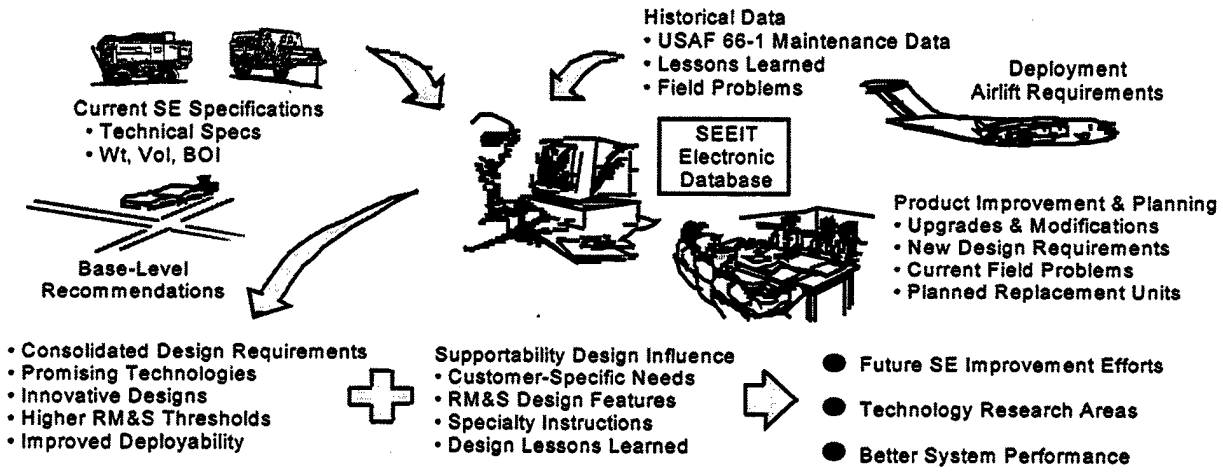


Figure 1-7. The SEEIT Database: A Valuable Tool for Future SE Development

Section 2.0
Problem Areas and Deficiencies

2.1 Field Visits and Interviews

Five different CONUS locations were selected for field visits to obtain a geographical cross section of user and maintainer comments of SE problem areas and deficiencies. It was thought that some SE problems may be caused by different geographical environments, therefore the origin of all comments collected was annotated by location. The dates of the field visits and the units visited are listed below.

10-12 Jun 96	Pope AFB, NC	23d Wing (ACC)	F-16, A-10, C-130
13-17 May 96	Luke AFB, AZ	56th Fighter Wing (AETC)	F-16
26-27 Mar 96	Kelly AFB, TX	San Antonio ALC (AFMC)	SE Depot
11-15 Mar 96	Mt. Home AFB, ID	366th Wing (ACC)	F-15, F-16, KC-135
22-25 Jan 96	Nellis AFB, NV	57th Wing (ACC)	F-15, F-16, A-10

Areas of particular concern included high SE repair times, poor usability characteristics, poor spares support (obsolescence), duplication of functions, recurring maintenance problems, and poor deployability features. Prior to the start of each group interview, each participant was asked to complete a general background information sheet to document his individual level of expertise and breadth of experience. This background information, along with the individual's AFSC, years of experience and present assignment location, have been transcribed into table format and have become an adjunct of the SEEIT automated database. Approximately 120 personnel from five different locations were interviewed. Also, two or three weeks prior to each interview, a sample questionnaire was distributed to give the personnel involved a feeling for the type of information being sought. By and large, the individuals who volunteered the most information (and were the most vociferous) had between 8 and 18 years of experience with the equipment under discussion. The younger troops also contributed many insightful comments. Examples of the individual background survey and the sample questions are included in the "Miscellaneous Reports" section of the automated SEEIT database.

To improve the accuracy of the data gathered, each field interview was tape recorded and later transcribed and reconciled against the handwritten notes. Various photographs and videotapes were also taken to document the identity of a particular piece of SE or its problem area. Many of the photographs have been digitally scanned and incorporated into the interactive SEEIT database.

A wide variety of information was captured during the five visits, and the problem areas show a great deal of correlation among the different locations. Cold and wet locales reported many of the same problems as the hot, dry stations. If one base reported that a particular piece of SE was a hard starter, had bad wiring, or needed a new battery every two months, there was generally an

unprompted consensus at the other bases. Severe corrosion seemed to be the exception. Many individuals had previous assignments to Saudi Arabia at bases that were located very close to the ocean. They cited examples of salt air corrosion that were more severe than at any CONUS base. Dirt and dust entrapment in the SE units also caused severe problems, particularly when attempting to clear the units through customs. Since these comments represented firsthand experience and the SE is still as vulnerable as before, the corrosion/hot desert discrepancies were documented as currently existing problems in the database.

All of the problem areas and deficiencies from the field visits have been transcribed into table format and are included in this report as Appendix 1. Since the comments are organized and presented by equipment type and specific model, the reader can easily view the similarity in comments from the different bases. During the assignment of problem area severity factors (as part of Task 3), similar or repeated problems were grouped together, then referenced to the most descriptive problem. Assigning only one severity factor to the referenced group ensured each was treated and counted as a single, unique problem. Each problem statement is also annotated to identify whether it impacts AGE/SE usability, reliability, maintainability, supportability, deployability, safety or is an administrative issue.

Problem area information has been integrated throughout the automated SEEIT database. This information accompanies many of the built-in report-generating features such as those linked to the technology assessments, which can be viewed by specific technology or equipment type. Problem area information may also be viewed in its entirety by individual equipment type and/or impact area.

2.2 Support Equipment Depot Issues

SEEIT team participants from Northrop Grumman and Lear Astronics visited Kelly AFB on 26-27 March, 1996, to discuss AGE/SE user and maintainer problems with San Antonio Air Logistics Center (SA-ALC) personnel. The information collected during this visit was provided by the SA-ALC engineering community and equipment specialists. The majority of the AGE/SE topics discussed revolved around procurement issues and pertinent lessons learned. This visit also provided SEEIT team members with the opportunity to verify and elaborate on information collected during previous base visits and field interviews.

Most conversations with the responsible engineers and equipment specialists included the following types of powered, major non-powered, and "dumb iron" AGE/SE:

- Air Conditioners
- Aircraft & Axle Jacks
- Start Carts
- Cranes & Hoists
- Floodlights
- Maintenance Stands
- Hydraulic Test Stands
- Towbars
- Jammers/Loaders
- Test Sets

Areas of discussion relative to the above items included: good/bad point summaries, known problem areas, deficiencies and remedies, quantities, overhaul frequencies, and new acquisition programs. A synopsis of the pertinent information received from the SA-ALC personnel interviews is included in this report as Appendix 1, Problem Areas and Deficiencies.

Some of the most serious depot issues discussed during the visit were related to corrosion control, lessons learned, and field feedback. The following paragraphs summarize these topics.

Corrosion Control
Corrosion control for the enclosures of powered AGE equipment is a major concern. The equipment's economic life was originally twelve years, but has recently been extended to fifteen. The equipment users and maintainers are beginning to experience the negative side of this decision. The environment is now taking its toll on the enclosures, as corrosion migrates wherever water can settle or become entrapped.

Expensive Lesson Learned
Implementing upgrades and modifications without proper procedures in place is a classic example of an expensive lesson learned on the MA-3D while switching from R-12 to R-137 refrigerant. The procedural change was not readily apparent to the users in the field, which stipulated they must shut down the system using a different procedure, or a compressor failure would occur. To further compound the issue, SA-ALC sent a field message out several months early requesting the users order the new TOs, but they were not delivered in time due to a late printing. Since the initial fielding, at least five compressors have experienced premature failure due to improper shutdown procedures. It is recommended that new T.O.s be shipped with the equipment, thereby ensuring the proper procedures are available concurrently with the modified equipment.

Field Feedback
Presently, engineers and equipment specialists at SA-ALC do not keep logs of AGE/SE field problem calls. Therefore, there is no substantiation (recall only) for prioritizing deficiencies for corrective action. Feedback and trouble reports from the field must have documentation in order to incorporate lessons learned, design changes, etc. The SEEIT database could be readily modified to accommodate tracking the status of problems reported from the field, in addition to providing an audit trail for the resolution and disposition of problems, recommendations for potential solutions, or requests for information and feedback.

2.3 Problematic Support Equipment

As previously mentioned, all of the problem areas and deficiencies from the field visits were transcribed into table format and have become an integral part of the automated SEEIT database. Because similar or repeated problems were grouped together and referenced to the most descriptive problem, a single problem area severity factor was assigned to each group. This ensures each grouping is treated and counted as a single, unique problem, thereby permitting the

SEEIT team to readily identify the most problematic equipment simply by summing the individual severity factors.

Figure 2-1 provides a summary of the ranking of the equipment types (descending order of summed severity factors) including the average, maximum, and minimum severity factors. Each specific SE item's contribution to the equipment type rankings can be viewed in the "Miscellaneous Reports" section of the automated SEEIT database. Section 5.1 of this report identifies several potential solutions to many of these problems, and Appendix 5 summarizes how the application of technology might impact the most severe problems (severity factor of 6 or greater).

Equipment Type	Total Problem Count	Severity Factor (S.F.) Sum Total	Avg S.F.	Max S.F.	Min S.F.
Ground Power/Start Cart	81	325	4.0	8	0
General SE	58	245	4.2	9	1
Test Set	59	227	3.8	7	1
Lift Truck/Jammer	43	181	4.2	7	2
Air Compressor	46	177	3.8	7	1
Hydraulic Equipment	46	155	3.4	7	0
Maintenance Stand	42	155	3.7	7	1
Servicing	34	133	3.9	7	2
Auxiliary Lighting	33	110	3.3	7	0
Misc. In-Shop Equipment	22	98	4.5	6	2
Air Conditioner	18	94	5.2	9	0
Trailer/Dolly	21	90	4.3	6	2
Deployment	27	84	3.1	5	0
Jack	22	77	3.5	5	2
Special Purpose Fltline	16	59	3.7	7	1
Environmental	16	53	3.3	5	1
Tow Vehicle/Truck	13	47	3.6	6	1
Gun/Loading	8	42	5.3	7	3
Tools	10	36	3.6	6	2
Heater	9	33	3.7	7	2
Towbar	7	28	4.0	6	2
Aircraft Deicer/Washer	5	11	2.2	3	1
Cargo Handling	2	11	5.5	9	2
Hoist/Slings/Cranes	3	11	3.7	6	2
CAMS	2	9	4.5	5	4
Facility	1	3	3.0	3	3

Figure 2-1. Ranking by Problematic Equipment Types

Section 3.0
Potential Solutions

3.1 Near-Term/Emerging Technologies

The purpose of the technology search of Task 2 was to identify near-term and emerging technologies that may be applicable to the objective of improving AGE/SE problem areas and deficiencies. To ensure this objective was met, data was also gathered on existing and near-term technologies for aircraft systems.

Research Strategy
Several different approaches were used as part of an overall research strategy to identify near-term/emerging technologies. The predominant approach was to search literature (both printed and electronic media) for articles describing new technologies. The search included trade journals (e.g., *Design News*), popular newspapers/magazines (e.g., *Scientific American, Aviation Week & Space Technology*), and industry newsletters (e.g., GEC's quarterly description of projects in its various labs), and the Internet. Many publications publish indexes of their articles which were used to streamline the search. Particular areas of interest included commercial airlines and other commercial applications, such as the automotive industry, which was thought to be more directly related to AGE/SE.

An additional method was to search for lists of technology endeavors. For example, the Advanced Research Projects Agency (ARPA) is administering a Technology Reinvestment Program (TRP) geared toward converting technologies that were originally explored for military purposes to the commercial arena. Also, the National Institute of Science and Technology (NIST), the National Science Foundation (NSF), and the National Aeronautics and Space Administration (NASA) all fund and administer technology development. Each of these organizations, and several others, maintain databases of the technology programs under their auspices. The various government labs (Lawrence Livermore, Sandia, etc.) also provided lists of their ongoing technology efforts, as well as DoD's Defense Technology Information Center (DTIC).

In addition, information was obtained from known entities in the AGE/SE community, including WPAFB Labs and AGE/SE manufacturers. Within DSC, the MAGSS (Multifunction Aircraft Ground Support System) and other support equipment programs were considered an excellent source of information which provided very good examples of integrated ground support functions.

Organization
After the lists of technology programs were obtained, the SEEIT team undertook a process of coarse "sifting" of the programs based on their applicability to AGE/SE issues. This first phase of evaluation simply eliminated from further consideration those technologies that were clearly outside the AGE/SE arena. The second phase of evaluation involved a detailed review of the

available literature on each of the remaining programs to further narrow the list of candidate technologies. The final list of technologies believed to have some potential for application to AGE/SE was then summarized in a database that presents the following information for each technology:

Synopsis of the Technology: This is a brief, one paragraph description of the technology, including the name of the company or institution performing the research and the name of the sponsoring agency.

Source of Information: This describes where the information on the new technology was obtained, which was generally from a printed publication, but also included broadcast media or personal interviews, so that any additional investigation or analysis of the subject matter could be performed.

Potential Application: This is a brief description of the areas where the technology may be relevant.

3.2 Potential Solution Examples

In Task 2, approximately 400 existing or near-term technologies were identified which appeared to offer promising solutions to many of the AGE/SE problems. These solutions ran the spectrum from direct application of technologies and information systems to changing policies and procedures. This effort ultimately identified nearly 1,000 potential technology-to-equipment type pairings for assessment in Task 3. Appendix 2 contains the technologies that were rated in the top 25 percent of the technology-to-equipment type pairings, along with other technology rating summaries.

The summed score for each technology assessed, as shown in Appendix 2, can be somewhat misleading. For example, to actually experience the amount of "goodness" derived from that particular technology, it would have to be applied across the board for each piece of equipment it was rated against. The summed value does have merit, however, when it is applied to technologies whose application would replace the functions of all the equipment types it was rated against, as is the case with the MAGSS unit and the Hepp Vapor Engine.

The "Miscellaneous Reports" portion of the automated SEEIT database is accessible through the Main Switchboard and contains additional information on the potential solutions and their respective assessments. The technologies which rated in the top 25 percent can be viewed at that location, along with the linked problem areas that would be impacted by application of that particular technology. The scoring summaries for the entire list of technologies is also readily available via this database feature.

Three typical examples of potential solutions/technologies identified during Task 2 of the SEEIT study are included below.

Modular Aircraft Staging System - Maintenance Stands

Synopsis: The Modular Aircraft Staging System is designed to give aircraft maintenance crews the quick deployment capability and other features of custom-designed work platforms at lower cost. In addition to straight work platforms, stairway, nose dock, over- and under-wing bridges and tail dock modules are available. The modules can be used alone or linked. Their height can be adjusted by up to 3 feet. Two people can easily move the modules, which feature a 1,323-lb capacity, 42-inch-high heavy aluminum guardrails, 12-inch-diameter casters with brakes, and steel end frames with integral twin jacks. Upright, Inc., 1775 Park St., Selma, Ca. 93662.

Source: Aviation Week & Space Technology, 12/19 Dec 1994, pg. 68.

Potential Application: These stands appear to be lighter in weight than current inventory stands. The modularity feature allows two stands to be used together, thereby decreasing the number of different stands needed on a deployment. With slight modifications, this type of stand could be made with quick knock-down features and alignment tabs to permit stable stacking. The 12-inch casters would allow 3 to 4 units to be stacked and rolled on an airlifter as a single unit by the loadmaster.

BFGoodrich's TempRite Low-Combustibility Thermoplastics

Synopsis: BFGoodrich has introduced TempRite LC low-combustibility thermoplastics designed for smoke and flame-regulated environments. The product is available in sheet form, as well as in compounds for profile extrusion and custom injection molding. Thermoformable with conventional ABS technology, the sheet products offer deep draw capability with superior texture retention, and are available in a wide variety of colors and decorative options. They also maintain durability and stability at elevated service temperatures and offer broad chemical resistance. They meet or exceed FAR 25.853 and Model Building Code Class A or 1, making the products suitable for applications such as commercial aircraft and mass transit interiors.

Source: Aerospace Engineering, Jan/Feb 1995, pg. 35.

Potential Application: With the wide-spread application of composite materials in flightline SE, it would appear to be very desirable to have composite components that are fire retardant. This would minimize the possibility of a "Corker" incident when composite materials burn and release long, thin, floating carbon filaments in the atmosphere which immediately settle in and short out electrical and electronic systems. Open cockpits are especially susceptible to Corker hazards.

Liquid Flow-Through Cooling for Power Supplies

Synopsis: Boeing is using liquid flow-through cooling in power supplies for the common integrated processors (CIPs) in the USAF's F-22. The module converts 270 VDC electrical power to 5 VDC. Each module has an output up to 400 W, and can operate in parallel with up to nine other modules, for a total output of 4,000 W. Polyalphaolefin liquid coolant flows through narrow channels in the module to cool these power supplies. The modules are designed to be line-replaceable within 15 minutes, with quick disconnect fittings for the coolant lines. The design gives a mean time between failure of 25,000 hours, and increases the maximum output of each module from 250 W to 400 W, according to Boeing. A module is 6.4 x 5.9 x 0.6 inches and weighs 1.8 lbs. Boeing recently delivered the first flightworthy power supplies to Hughes Aircraft, which builds the CIPs.

Source: Aviation Week & Space Technology, 26 Feb 1996, pg. 41.

Potential Application: The technology concept of a liquid cooled avionics suite has the potential to reduce the requirement for certain pieces of flightline support equipment, such as -10 air conditioners. Although considered state-of-the-art, the F-22 avionics suite required a new piece of ground support equipment (called the PAO cart) to circulate the polyalphaolefin coolant during ground maintenance. As this technology matures over the next few years (as well as electronics that emit less heat), on-board, flow-through liquid cooling will totally eliminate the requirement for ground-based air conditioners.

Section 4.0
Technology Assessment

4.1 Assessment Overview

The SEEIT Task 3 evaluation of potential technological solutions required a panel of knowledgeable personnel to assess the degree of improvement each technology might contribute to every equipment type and problem area to which it was linked. SEEIT Team personnel performing the assessments were comprised of AGE/SE users, maintainers, developers and personnel from the operational requirements, integrated logistics, and design-to-cost communities. The SEEIT team's assessment panel jointly established the task objectives and exit criteria, as well as a systematic approach and evaluation criteria for each step of the process. The process consisted of six distinct steps:

Process Step	Evaluation Criteria
1. Problem Severity Assessment	Problem severity scale as a function of mission impact on critical flightline activities
2. Technology-to-Equipment Type (Top Level Assessment)	Ability of a given technology to improve the equipment type performance as measured against the problem severity. Scored on a percentage basis, based on number of problems addressed.
3. Technology-to-Equipment Type (Detailed Assessment)	Ability of a given technology to remedy linked problem areas. Scored on a percentage basis of effectiveness in solving "linked" problems.
4. Technology Assessment	Evaluation Criteria Checklist for impacts to Usability, Reliability, Maintainability, Safety, Supportability, Deployability, and Administrative. Consideration was given to latent or inherent benefits independent of specific problems in an impact area. Scored on a point basis as a function of relative benefits.
5. Risk/Cost Assessment	Risk/cost matrix consisting of 8 cost-related criteria and 4 risk-related criteria to address affordability and technology maturity/complexity. Scored on a point basis as a function of combined cost and risk.
6. Prioritization Assessment	SEEIT Panel review of highest payoff technologies by highest problem severity and by highest mission impact problem type.

The technology assessment process has an analytical, algorithm-based approach for evaluation of both problems and candidate solutions. The evaluation is based on a point system that is applied to each area of evaluation. A significant degree of importance is placed on the technical and operational expertise and judgment of the evaluators. For the SEEIT Program, a panel of evaluators was selected to create a representative cross section of AGE/SE-related disciplines in an effort to assure a composite assessment of each evaluation area. The scoring scheme used panel-developed rationale and written guidelines for each evaluation area. Each panel member conducted an independent assessment of the item under review. The individual scores were tallied and averaged to determine a net score for the item under evaluation. In situations where a large differential existed between panel member scores, a discussion ensued on the disparate scoring rationales. When merited, the scores were adjusted for the final value. The SEEIT Program members agreed that the multi-disciplined, panel-based approach provides the optimum balance in assessment. However, the standardized evaluation criteria and scoring system could be used by an individual to maintain and expand the database in the future to address additional support equipment types, problem areas, and candidate technology solutions.

Each technology-to-equipment type pairing was assessed in seven key impact areas: Usability, Reliability, Maintainability, Supportability, Deployability, Safety, and Administrative. Each impact area score (0 - 10) was weighted by the highest problem severity factor within the respective impact area for that particular piece of equipment and then summed. The Risk/Cost associated with the implementation of a particular technology was assessed individually and scored with the aid of a matrix (0 - 100), which accommodated a very low risk/very low cost to very high risk/very high cost rating scheme. The following subsections provide a more in-depth description of the Task 3 assessment process, the criteria used to supplement each assessment, the risk/cost matrix, and the rationale used for the assignment of problem area severity factors.

During the assessment process, many of the technology-to-equipment type pairings and problem area links were revisited and slightly revised, which reduced the number of individual assessments to 735. Each assessment, accompanied by the scoring rationale, can be easily reviewed in the automated SEEIT database. Additionally, Appendices 2 and 3, respectively, identify technologies with potentially high payoff and provide an overall technology rating summary.

4.2 Problem Severity Factors

The first step taken in the Technology Assessment (Analysis and Assessment of Potential Solutions) process was to methodically review the Task 1 listing of problems and deficiencies. Two important initial observations affected the problem review:

1. There were a significant number of problems that were linked (common failure cause) to one another by equipment type, even though the sources of the problem statement varied by survey site.

2. A number of the "problem statements" did not state or identify a specific problem; rather, it was simply a comment or observation.

The SEEIT problem review team recognized that many expressions of the same or very similar problem could potentially skew the database from a statistical perspective. Thus, a problem that was stated more than once, usually with different terminology by different survey personnel, received special treatment. The clearest or most descriptive statement of the problem was identified as the "principal" problem statement. All the similar statements for the same or very similar problem were then referenced to the principal problem number. Later, as problem severity factors were assigned to each problem, care was taken to be consistent in the rating treatment of both the principle statement and the referenced problem statements. This approach minimized redundancy and inconsistency when addressing the initial 1,400 problem statements. In addition, the severity of a given problem was not statistically biased by more than one statement of the same or very similar problem.

Of the initial problem statements collected in Task 1, some did not identify a specific or generic problem. Rather, they provided a comment or observation regarding AGE/SE. While such statements were not directly relevant to the actual SEEIT objective, they were, nonetheless, maintained in the database to assure that all field inputs were preserved. The SEEIT team believes these comments have potential reference value to certain SEEIT database users. For example, some comments provide information as to planned events, such as the procurement of replacement equipment that could influence the direction taken in the application of candidate solutions to a particular item or equipment type. These comments and observations were given special treatment in the problem severity evaluation by the assignment of a "Not Rated" (NR) code.

Problem Relevance to Key Impact Areas

Each problem was initially classified as to its relevance to one or more of the seven key impact areas: Usability, Reliability, Maintainability, Supportability, Deployability, Safety, or Administrative. A matrix-type table was developed and added to the problem summaries by equipment type. For simplicity, a check-off approach to identify the impact area or areas that relate to the problem listed was used. Impact area relationships are included with Appendix 1, SEEIT Problem Areas and Deficiencies, and can also be viewed in the "Miscellaneous Reports" portion of the automated SEEIT database. This table was later used in conjunction with the problem severity rating to determine the overall rating for each candidate technology solution.

Problem Severity Rating

The review and assessment of each problem statement and the subsequent assignment of a severity rating was based primarily on real or potential impact to the aircraft mission. The focus of this assessment was to determine at what level the AGE/SE problems and the affected maintenance directly or indirectly affect mission readiness, sortie launch, or maintenance recovery. Two additional critical factors were also strongly considered in the assessment and rating process: 1) potential safety issues or concerns for personnel and/or aircraft, and 2) hazardous material considerations and potential safety hazard or an adverse environmental impact.

The problem severity rating was based on the "SEEIT Problem Severity Scale" developed by the SEEIT team. The severity scale ranges from zero (0) to ten (10) in increasing degree of mission impact. The zero value on the continuum scale represents the least extreme in terms of problem severity with "No Impact" on the operational mission. The ten value on the opposite end of the scale represents the most extreme impact, indicating a "Probable War Stopper" situation. The full scale used to determine the degree of mission impact for each problem is depicted in Figure 4-1, below.

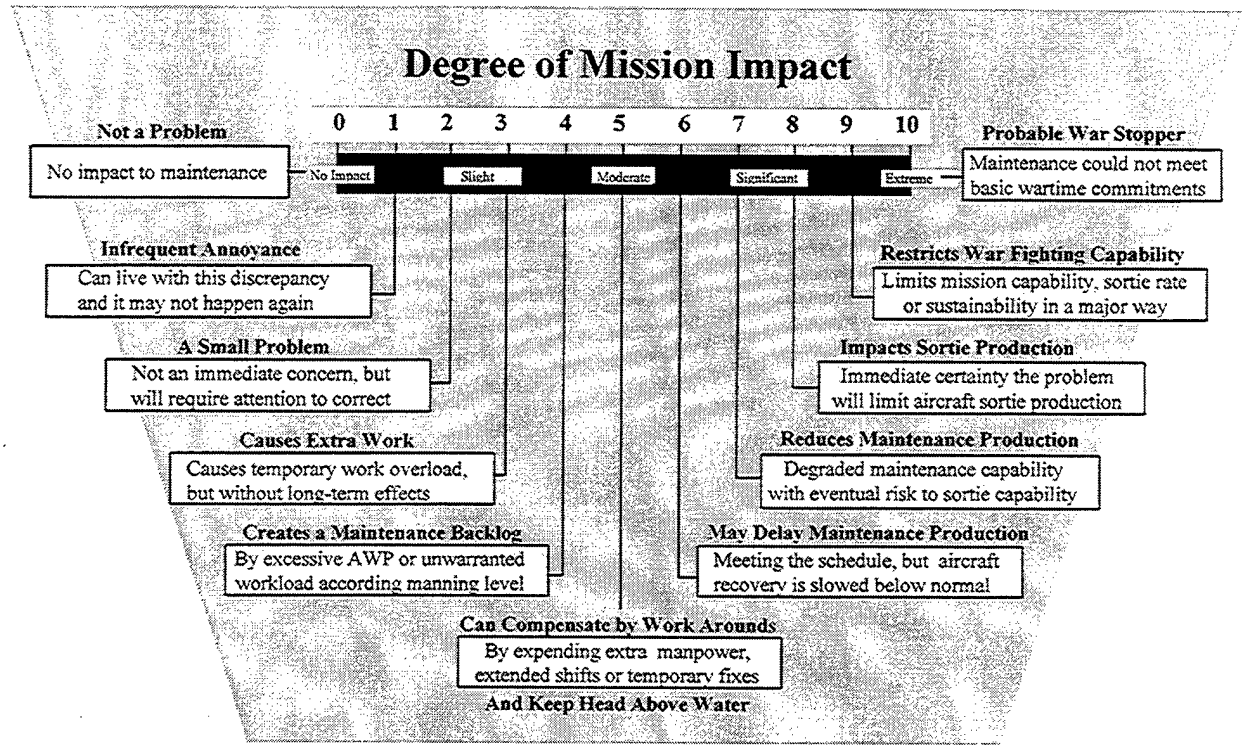


Figure 4-1. SEEIT Problem Severity Scale

The evaluation of each problem was conducted by a team of five evaluators. The team was composed of personnel with directly applicable AGE/SE expertise and experience. Disciplines represented included the user, maintainer, designer/developer, military pilot, and integrated logistics support. This multi-discipline perspective was beneficial in generating a comprehensive evaluation.

The results of the problem severity evaluation became an integral portion of the SEEIT database and are contained in Appendix 1. The problem areas with a severity factor of five (5) or greater are of significant importance, as this is the point where cost and schedule begin to seriously affect mission performance due to AGE/SE nonavailability or impaired maintenance response.

In addition, the ability to distinguish unique problem statements from duplicates made it possible to determine the "Unique Problem Count" for each Equipment Type. However, determination

of the most problematic Equipment Type must include not only problem count, but also problem severity. Therefore, the sum of unique problem severity factors was calculated for each Equipment Type, and then sorted in descending order, which resulted in a ranking of the "Most Problematic Equipment". This ranking was later used during Task 4, to address Technology Impact by Problematic Equipment Type.

4.3 Assessments by Equipment Type

The assessment of technologies by equipment type utilized a streamlined Quality Functional Deployment (QFD) methodology to address an extremely large set of data and variables. The objective of the assessment was to rank and prioritize technologies by how well they solved the most severe equipment type problems.

The key variables addressed in the process consisted of:

Problem severity
Technology impact
Risk/Cost factor

The process for conducting technology assessments by equipment type consisted of the following steps:

Categorization of Equipment by Type
Categorizing equipment **items** into equipment **types** was a logical first step in the SEEIT database development and was reviewed during Task 3 for completeness and accuracy prior to performing any actual technology assessments. For example, the various models of air compressors (such as MC-1A, MC-2A, and MC-7) were grouped into the equipment type "Air Compressors". This approach allowed the assessment to address a "family" of common AGE/SE to provide a full perspective of problems and candidate technology solutions. Based on the sum of unique problem severity factors, the equipment types (families) could be prioritized as to which type were the most problematic and could benefit the most from the application of candidate technology solutions (Technology Impact by Problematic Equipment Type).

Problem Linking
As candidate technology solutions were collected and documented, each was linked to all applicable equipment types, then to each problem area that may be impacted by application of the particular technology. Technologies linked to equipment types and problem areas were then used to support the Detailed Technology Assessment described below.

Top Level Assessment
A top level assessment of the ability of a candidate technology to improve the performance of the equipment type was conducted with respect to each impact area (Usability, Reliability, Maintainability, Supportability, Deployability, Safety, and Administrative). This assessment addressed all the problem areas and deficiencies listed for a given equipment type. A point scale

was used ranging from zero (0) to four (4) based on the percentage of total problems that could be impacted by application of the candidate technology.

Detailed Assessment

An assessment of the ability of a candidate technology to remedy linked problem areas was performed as a refinement of the Top Level Assessment. This process also presented a review of problem area severity and impact areas. Scoring for this assessment was also on a point scale from zero (0) to four (4) based on the percentage of total linked problems that could be remedied by application of the candidate technology.

Extended Benefit Assessment

Using the "Evaluation Criteria Checklist" as a guideline for assessment (see Figure 4-2), the evaluators reviewed each technology to determine if any latent or inherent benefits existed for the application of the technology. This assessment considered the benefits of a candidate technology, even if a specific problem or group of linked problems was not directly addressed by the technology. Thus, a measure of merit beyond the immediate problem solution was developed for all identified technologies.

Scoring in this assessment area consisted of an overall point scale of zero (0) to three (3). The evaluation required the collective knowledge and experience of the SEEIT panel for objective judgments. The scoring scale was adjusted to address situations where there were no problems in the Impact Area affected by the technology and thus no severity factor existed. In such cases, based on the potential for latent benefit, a score greater than three (3) was possible. Otherwise, scores for technologies directly affecting an impact area ranged from zero to three.

Risk/Cost Assessment

The evaluation criteria for determining risk/cost factors for use in a risk/cost matrix was developed based upon eight cost-related considerations and four risk-related considerations. These considerations were:

Cost-Related Considerations

1. Reduced Average Unit Production Cost
2. Reduced Weight/Volume Requirement for Deployment
3. Reduced Deployment Cost (Hdwr/Software)
4. Reduced O & S Cost
5. Improved Reliability, Maintainability and Supportability
6. Cost to Implement New Technology (Upgrade, Modification, or Enhancement)
7. Development Cost
8. Total Procurement Cost

Risk-Related Considerations

1. Maturity of Technology
2. Maturity of Design (Hardware/Software)
3. Complexity of Design
4. Level of Specification (Comm/Military)

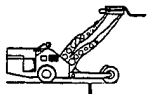
Usability

- Ease of SE Operation, Preparation, Warm-Up
- Minimal User Training Requirements
- Improved Fltline Towability/Transportability
- Ease of Positioning & Hook-Up
- Readability of Dials, Gauges, Controls
- Control Panel Ergonomics/Adjustability
- Adequate Fuel Capacity for Extended Jobs
- Minimal Auxiliary Eqpt/Hoses/Cables/Wires
- Better Hose & Cable Storage Provisions
- Minimal Ancillary SE/Test Sets/Adaptors
- Expanded SE Utility/Interoperability

Reliability

- Improved Hardware/Component Robustness
- Reduced Secondary (Induced) Failures
- Less User-Induced Failures Due to Design
- Reduced Parts Count/Complexity
- Improved Fault Tolerance/Redundancy
- Improved FD/FI Capabilities
- Improved Shelf Life of Expendables
- Improved Durability of Seals, Hoses, Valves
- Reduced Susceptibility to Vibration
- Improved Environmental/Corrosion Protection
- Better Component Location to Reduce Failures
- Better Compatibility to Acft Parameters

Maintainability

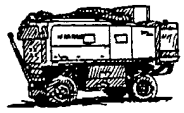


- Reduced Maint Frequency for SE
- Reduced Repair Times for SE
- Reduced Servicing & Inspection Rqmts
- Less Scheduled Maintenance for SE
- Fewer SE Maintainer Requirements
- Improved Accessiblity/Modularity
- Reduced Scheduled Maintenance for SE
- Fewer/Simpler Tools and TOs for SE Repair
- Less Specialized Training for SE Maintainer
- Minimal Attaching Hardware
- Improved FD/FI Capabilities
- Parts/Eqpt Commonality Among SE Types
- Improved R&R at Lower Component Levels
- Minimal SE Types Doing the Same Function
- Expanded Organic Repair Capability/Local Mfg
- Reduced Calibration Requirements

Safety

- Fire or Electrical Hazards
- Temperature or Acoustical Hazards
- No Fail Safe/Mechanical Hazards
- Falling or Tripping Hazards
- Lack of Visibility While Working
- Maintainer Size/Strength Requirements
- Toxic Gases or Chemical Hazards - HazMat

Supportability



- Fewer Spares Required/Less Stockage
- Less Consumables/Fuel/Oil/Lube Required
- Longer-Life Batteries, Tires, Paint, Brakes
- Fewer Manpower Skills/Trng Required
- Less Facilities Required
- Improved Depot Support
- Extended Overhaul Intervals
- Greater Parts Commonality
- Improved Tech Order System for SE
- Better TCTO Support & Eqpt Update for SE
- Better Supply Support for Obsolete Parts
- Pkging, Handling, Shipping & Transportation
- Better Implementation of HazMat Programs
- Improved Availability of SE/Basis of Issue
- Better Operability at Remote Site Environs
- More Economical Operating & Maint Costs

Deployability

- Denser Packing for Palletized Cargo
- Prefer More Pallets and Less Rolling Stk
- Better Deployment Bin Concepts
- Modular SE for Less Wt & Cube
- Reduced Amount of Deploying SE
- Less Outsized and Oversized SE
- Foldaway/Removable Tongues for SE
- Better Brake Controls for Rolling Stock
- Innovative SE Stacking/Nesting Provisions
- Less Winching of SE/Too Time Consuming
- Reduced Spl Handling/Purging Rqmts
- Better Asset Tracking & Control System
- More Reliable Cargo Handling Eqpt
- Larger Capacity Material Handling Eqpt
- Better Roll On/Roll Off Efficiency & Safety
- Less Oxidizers/HazMat Materials
- Less Personnel, Spares, Consumables

Administrative

- Slow Update of Tech Orders
- Excessive Proliferation of Tech Orders
- Poor Provisioning/Lack of Spares
- Excessive Paperwork Requirements
- Expand/Improve E-Mail Databases on SE
- Loss of Sole Source Venders/No Backups
- Slow Approval for Tech Order Deviations
- Inability to Requisition Parts/ Not Orderable
- Slowness of QDR/ECP Programs
- Not Using CAMS for SE Documentation
- Poor Item Mgr Support/Lack of Knowledge
- Lack of Standardized Hazmat Handling Instr
- Slow Approval to Use Commercial Items

Figure 4-2. SEEIT Evaluation Criteria Checklist

The following risk/cost matrix (Figure 4-3) was used as a guide for assigning composite point values to the risk and cost factors as defined above:

			Cost*				
			Very Low 0.0	Low 12.5	Medium 25.0	High 37.5	Very High 50.0
Risk	Very Low	0.0	0	15 - 20	25 - 30	40 - 45	50 - 55
	Low	12.5	15 - 20	25 - 30	40 - 45	50 - 55	65 - 70
	Medium	25.0	25 - 30	40 - 45	50 - 55	65 - 70	75 - 80
	High	37.5	40 - 45	50 - 55	65 - 70	75 - 80	90 - 95
	Very High	50.0	50 - 55	65 - 70	75 - 80	90 - 95	100

* Cost is evaluated in relation to the existing SE technology.

Figure 4-3. Risk/Cost Scoring Matrix

Technology Ranking by Algorithm

Following the independent assessments for each Technology-to-Equipment Type pairing in each impact area, composite scores were achieved through the use of a simple algorithm that multiplied and summed the problem severity values with the mission impact scores of the respective technology. The risk/cost scores were treated as independent elements and not included in the algorithm.

Overall Benefit Rating

The result of this Assessment process was that each Technology-to-Equipment Type pairing was assessed in seven separate Impact Areas, each receiving a possible score of 0-10. A composite score was then obtained by the use of the following algorithm: For each Impact Area, the Impact Score was weighted by the maximum Severity Factor of only the linked problems with an "x" in that Impact Area matrix. This resulted in seven distinct Benefit Subtotals, which were then added together for the composite score, or Overall Benefit Rating.

4.4 Technology Application vs. Redesign

The technology search phase identified approximately 400 candidate technologies for consideration in Task 3, Technology Assessment. A complete list of these technologies, along with their respective scores for each assessment performed, is included as Appendix 3. The synopsis and potential application for each technology can be viewed in the "Tech Analysis" and "Miscellaneous Reports" portions of the automated SEEIT database.

It is important to note that the candidate technologies vary greatly in their level of maturity. Many technologies, such as Low Cost Composites and the Multifunction Aircraft Ground

Support System (MAGSS) exist today and are readily available for application to AGE/SE problems. Other technologies such as the Hepp Vapor Engine and the Split-Cycle Engine are far-term, advanced concepts requiring additional research, design and development.

Technology Application

As with all newly-introduced technologies, there will obviously be some level of engineering redesign required to solve a particular problem. For example, the Electrohydrostatic Actuator (EHA) is a mature technology and could be used to replace problematic hydraulic systems on GSE. In applying this type of technology, a non-recurring engineering design effort would be necessary to assess the existing hydraulic requirements of the equipment, size the EHAs to meet those requirements, and design a modification kit to retrofit the equipment.

Comprehensive Engineering Redesign

In many cases the engineering design effort itself can be considered a potential solution. Problems identified during Task 1, such as the inability to drain fuel tanks and fuses blowing during start-up, appear to be a result of poor design practices, or simply design errors which make the GSE difficult to maintain or cause equipment failures on the flightline. A Comprehensive Engineering Redesign (CER) effort could be applied to these types of problems to identify the root cause of the malfunction, design a solution which would not necessarily include the application of a new technology, and then develop a retrofit or modification kit to correct the condition.

Evidence of the effectiveness of CER already exists in some of the field modifications reported in Task 1. One classic example of an effective field modification is the relocation of the starter solenoid on the MJ-1 munitions loader to prevent overheating. Although not ultimately approved by the Air Force, this simple modification would eliminate the recurring problem of blowing the 20 amp fuse during start-up. Another excellent example is the simple replacement of the stock sloot air line clamps on the -10 air conditioner with Wiggins fittings, which has reportedly prevented numerous catastrophic failures and saved countless maintenance manhours.

Supplemental Assessment

During the Task 3 Technology Assessment phase, it became apparent that a significant portion of the 1,400 problems from Task 1 would not be most effectively solved through the application of a new technology. Many of the problems appeared to require simpler and less costly solutions, such as the selection of better commercial off-the-shelf (COTS) components or the application of a comprehensive engineering redesign (CER) effort. To better quantify this observation, a supplemental assessment of the Task 1 problem set was performed to classify the problems according to the problem's most logical solution.

This assessment resulted in the 1,400 problems being grouped into seven different categories. A listing of the seven categories, along with a definition of each, is as follows:

- Increase Basis of Issue - This category included those problems which would be best solved by increasing the basis of issue in the tables of allowance for the piece of equipment.

- Improve Markings, Cautions, TOs - Problems in this category could be resolved by improving markings or CAUTION labels on the GSE, and by correcting or expanding the Technical Orders or improving documentation in general.

- Apply CER - This group includes all problems that could be resolved through an engineering redesign effort which would not necessarily require the application of any new technology. The comprehensive engineering redesign effort would identify the root cause of a problem and implement a design change to resolve it. All problems that received a CER rating in the Task 4 assessment are included in this group.

- Install Better COTS Part - In many cases a problem is caused by parts that are defective or do not meet their originally-specified requirements. Included were those problems that could most likely be resolved through the identification and installation of a better commercial off-the-shelf (COTS) part. All problems receiving an IMA (Item Manager Action) rating in the Task 4 assessment are included in this group.

- Apply New Technology for Solution - This group includes those problems which would best benefit from the application of a new technology. It is assumed that the new technology would also require engineering effort for proper application and possibly R&D effort to mature the technology. All problems that received an R (Research) or P (PWIG) rating in the Task 4 assessment are included in this group.

- Improve Training / Management - This group includes problems that would most likely be resolved through improved training, implementing a better administrative process or increased attention by management.

- Comments Only (No Action Required) - All problems that were merely comments, observations or suggestions were included in this group.

Refining the Assessment Data

Before a proper analysis of this assessment could be performed, it was necessary to filter out potentially misleading information. First, the category classifications for all referenced problems from the Problem Severity ranking were grouped and treated as a single, unique problem. This is important because the referenced problems were in effect duplicate entries of the same problem within the set. If they were left in, the results would be skewed by the repetition. The elimination of the 418 referenced problems reduced the problem set from 1,403 to 985.

Second, these parallel assessment results were compared against the results of one of the assessments conducted during Task 4 which rated and prioritized technologies against the most severe problems. The results of this Task 4 assessment (which identified priorities in attacking problems with a severity factor greater than five) are included in Appendix 5, Technology Priority by Problem. Where the parallel assessment differed, the result was adjusted to agree

with the Task 4 first priority to ensure better alignment of the results. The effect of this comparison is shown in Figure 4-4, below.

Group Description	Number of Problems	After Adjustment	Delta
Increase Basis of Issue	23	24	+1
Improve Markings, Cautions, TOs	41	41	0
Apply CER	407	402	-5
Install Better COTS Part	79	82	+3
Apply New Technology for Solution	124	140	+16
Improve Training / Management	15	44	+29
Comments Only (No Action Required)	296	252	-44
Totals	985	985	0

Figure 4-4. Comparison to Task 4 Results

The comparison revealed that only 5 percent of the problems actually differed from the Task 4 results, which lends credibility to the results of both assessments. Note that no comparison was made for problem severity factors of 5 or less, as they were not individually addressed in Task 4.

Finally, the Comments Only group was eliminated as they were not problems but comments, observations, or suggestions which did not require a solution. This refinement reduced the problem set by 252 to 733 distinct problems.

Results and Conclusions

The results of this supplemental assessment clearly support the premise that the application of new technology is not the most effective means of solving the majority of the AGE/SE problems. Comprehensive engineering redesign would be the best approach to solving 55 percent of all problems identified, followed by the application of a new technology which would solve 19 percent. Figure 4-5 graphically displays the relative sizes of the six classification groups.

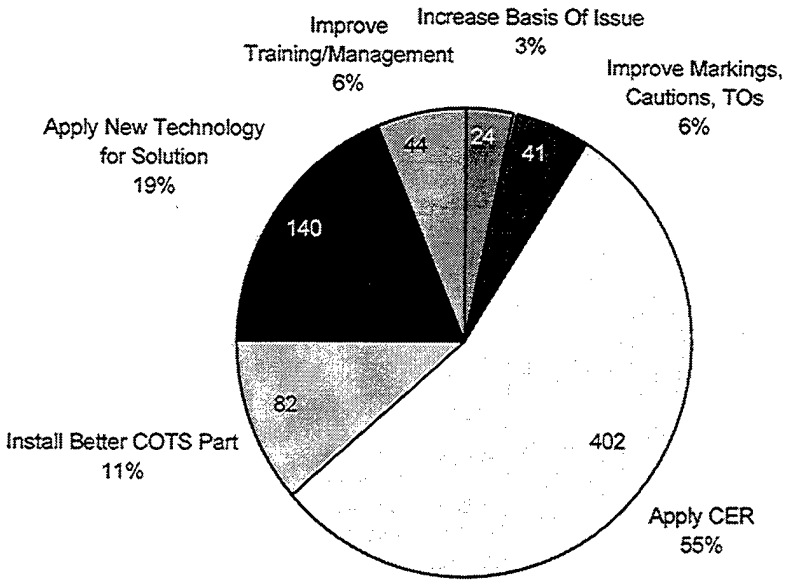


Figure 4-5. Final Problem Classification Results (Excluding Comments)

Section 5.0
Recommendations and Conclusions

5.1 Problematic Equipment Solutions

One of the most logical and potentially effective approaches to solving AGE/SE problems is to address the pieces of equipment or equipment types with 1) the largest number of problems and 2) the highest severity problems. These equipment types, referred to as problematic equipment in earlier sections, were identified by summing the individual severity factors as shown in Figure 2-1. The following is a discussion of the five most problematic equipment types identified by the field interviews and subsequent severity factor analysis. Problems associated with each equipment type are summarized, along with their potential solutions.

Ground Power/Start Cart

This equipment type encompasses a range of flightline equipment items including combined electrical power generator/pneumatic start units such as the -60 and -85, pneumatic start carts such as the -95 and MA-1A, and electrical power generator sets such as the MD-4, MEP-105, and -86. This family of equipment is characterized by high rates of utilization for flightline operations, and as such, are considered mission critical pieces of AGE. The Ground Power/Start Cart equipment type ranked number one in terms of having the highest problem count with the highest severity factors.

The highest severity problems are typically those that create a significant safety issue relative to either operator or aircraft, a foreign object damage (FOD) condition, an environmental concern as the result of hazardous material conditions, or result in a significant impact to aircraft sortie generation. The highest severity problems associated with the Ground Power/Start Cart equipment type are summarized as follows:

Problem Summary

1. Electrical cable failure modes that can result in a short circuit condition which potentially endangers the operator and/or can create a fire. (Reference: problem ID #87, -86 Generator Set, severity factor 8; and problem ID #88, -86 Generator Set, severity factor 7).

2. Fuel-related problems, including fuel tank design and leakage issues, connection and seal leakage, fuel component leakage (e.g., valves) were identified for three separate items in this equipment type. In each case, a condition involving fuel resulted in an unsafe operational condition or inability to operate. (Reference: problem ID #278 and #944, -85 Generator Set (GPGS), severity factor 6; problem ID #89, #90 and #1155, -86 Generator Set, severity factor 6; and problem ID #227, -95 Start Cart, severity factor 6).

3. Prime mover problems (engine and engine-related) were identified in several cases as creating a potentially unsafe condition and/or limiting the utilization of the equipment item. (Reference: problem ID # 226, MD-1A Start Cart, severity factor 6; problem ID #243, MD-4 Generator, severity factor 6; problem ID #78 and #79, -86 Generator Set, severity factor 7, problem ID #272, -85 Generator Set (GPGS), severity factor 6; and, problem ID #1298, -60 Generator Set, severity factor 5).

Conclusion

The unit with the highest numerical problem count and the highest problem severity factors is the -86 Generator Set. Second in numerical problem count but with lower total severity factors is the -60 Generator Set (a combined pneumatic start and electrical power generator unit). Based on the apparent utilization rate of these equipment items and the number of problems and severity of problems, these items are the most likely candidates for significant improvement through the application of either comprehensive engineering redesign (CER), the application of technology solutions, or a combination of both.

Technology Solutions

Forty-seven percent of the most severe problems identified for the Ground Power/Start Cart equipment type are believed to be addressable, with a comprehensive engineering evaluation and redesign effort as the highest priority. In such a manner, many of the problems may be solved quickly and affordably.

Twenty-six percent of the most severe problems can benefit from the application of technology solutions as the first priority. However, more detailed research is likely to be required to determine the best method of application and the degree of benefit received. For example, composite structures can be used to solve weight-related problems but additional research is required to determine the best approach and the cost of such an approach.

Sixteen percent of the most severe problems were determined to require Item Manager Attention as the first priority to reach a problem solution.

On an item-by-item basis within this equipment type, total unit replacement for certain problematic items may be a consideration, however, it was not shown as a priority at level 1, 2, or 3 for any item. In some cases, such as the -85 Generator Set (GPGS), the field survey indicated that equipment is already being retired or replaced as part of a planned procurement.

General SE

The "General SE" category catalogued problem statements that were not directed to a specific equipment item. This category of equipment problems was more general in nature and addressed the full range of AGE/SE.

Problem Summary

1. The single most severe problem identified involved the potential inability to decontaminate an avionics workstation due to the cooling fan. (Reference: problem ID #663, severity factor 9).

2. The most common problem area identified, though at a lower severity factor, related to fastening devices. Problems included loose or missing fasteners, poor fastener retention, and issues of FOD and safety concerns due to fasteners. (Reference: problem ID #213 and #1418, severity factor 7).

3. Prime mover-related problems (engine-induced) were identified, which included issues of safety and supportability due to hard starting, cold weather starting, post ignition, wet stacking, exhaust stack fires, high noise levels, and exhaust emissions. (Reference: problem ID #1405 and #1410).

Technology Solutions

All of the most severe problems identified for the General SE category could be improved or eliminated through potential technology solutions. However, in each case, further research is necessary to fully evaluate the merit and cost effectiveness of a specific candidate technology.

Fourteen candidate technology solutions were identified for the most severe problems identified in the broad General SE category. Of these fourteen candidate solutions, five focused on fastener improvements in one form or another. Based on the problems associated with fasteners as noted above, further pursuit of the five identified technologies, and a search for similar technologies are believed to be the most beneficial for this equipment type category.

Test Sets

The Test Set equipment type includes a wide range of equipment, composed of thirty-eight individual items. Items include Auto Flight Control Test Sets, AIS, Carbon Seal Testers, ECS Testers, F-16 Testers, Engine Vibration Analyzers, Fire Control Test Sets, Memory Loader Verifiers, and various test instruments (meters and instruments). Many items had only one problem identified and only a few items had more than six problems identified. Severe problems, such as those rated with a factor of six (6) or higher, were very limited. As a category, the Test Sets equipment type contained a larger number of items with a relatively limited number of problems per item and few severe problems in total. However, when summed, this equipment type ranked third among all equipment types.

Problem Summary

1. The most significant problems were safety issues and operational difficulty for various items in the Test Set equipment type. Two important examples are the potential for operator shock from the Gun Fire Test Set in the event that a ground wire connection is lost (reference: problem ID #1337) and a large cable design on the AIS that results in more difficult LRU repair and maintenance.

Technology Solutions

For a large number of the problems identified for the Test Set equipment type, the severity factor is low (below 5) and the impact on the aircraft mission is low. However, as a category, the Test Set equipment type has a large number of small problems. In many cases, on an item-by-item basis, a comprehensive engineering redesign (CER) is likely to have an immediate potential benefit at an affordable cost for most of the basic problems.

Due to the general electrical or electronic nature of the items in the Test Set equipment type, technologies that improve the reliability of an item in its day-to-day use are of interest. Only one technology of this type (ID #340, Gold Dot Technology for Oxide-Free Electrical Contacts) was identified as having immediate potential benefit in improved reliability. The remaining technologies need further research to determine the degree of applicability and viability to the problems in this equipment type. Further research into other similar or derivative technologies is also recommended in addressing the wide range of problems identified in the Test Set equipment type.

Lift Truck/Jammer

The Lift Truck/Jammer equipment type includes the Manually Operated Lift Truck (MOLT), the MJ-1 Jammer, MHU-83 Jammer, the MJ-4 Jammer, and the MJ-40 Jammer. In this equipment type, there were eight problems identified with a severity factor of six or greater. The majority of these problems (seven) were attributed to the MJ-1 Jammer.

Problem Summary

1. Prime mover (engine-related) problems affected item reliability and maintainability.

2. Fuel-related problems created potentially unsafe conditions endangering operator and/or aircraft.

3. A hydraulic system problem created a potentially unsafe condition endangering the operator.

Technology Solutions

Seventy-five percent of the most severe problems identified for the Lift Truck/Jammer equipment type can be addressed with a comprehensive engineering review and redesign effort as the highest priority. All of these problems are associated with the MJ-1 Jammer.

The second priority for the MJ-1 Jammer is a complete replacement with a unit having improved features (reference: technology solution ID #297, RAZ and miniRAZ Munitions Handling Trolleys).

One potential technology solution, ID #330 (Circuit Breaker Switch Panels), was assessed as a Priority 1 candidate for addressing a high severity factor problem with the MJ-4 Jammer. It is recommended that the PIWG implement this technology or a similar technology to solve the identified problem.

The hydraulic system on the MJ-1 poses a potential safety of operation concern. It is recommended that the Item Manager address this problem via a TO update and/or warnings and cautions.

Air Compressor

The Air Compressor equipment type encompasses a range of diesel engine-driven and electric motor-driven units, including the MC-1A Compressor, the MC-2A Compressor, and the MC-7 Compressor. Problems with the highest severity factor are distributed relatively uniformly among all three compressor types. The highest severity problems are typically those that create a significant safety concern relative to either operator or aircraft, a FOD condition, or result in a potentially significant negative impact on maintenance and mission generation. Thirteen high severity factor problems were identified for the Air Compressor equipment type.

Problem Summary

1. Moisture-related problems affected the reliability of the units (compressor oil contamination) and the performance of the units in supporting aircraft (moisture in the delivered air supply), and is the apparent root cause of aircraft electrical component failure.

2. Fastener usage and retention was identified as a potential FOD concern.

3. On engine-driven units, fuel leakage problems, generally relating to excessive engine vibration, created unsafe operating conditions and increased unit downtime.

Technology Solutions

Fifty-four percent of the highest severity factor problems can be addressed by a comprehensive engineering evaluation and probable redesign as the near-term, low cost/low risk approach.

Thirty-one percent of the highest severity factor problems (four total) can be addressed with technology solutions that require little or moderate additional research to implement. These problems and solutions are recommended for PIWG attention as follows:

- Problem ID: 144 - Manufacturer's switches are faulty due to corrosion from water intrusion. The glow plug switch next to the fuel filter would short out due to corrosion, and the unit would catch on fire.

  - Technology ID: 201 - Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches.
  - Technology Score: Score of 37 for the Air Compressor equipment type. Total score of 88 for all equipment types.

- Problem ID: 145 - Voltage regulator shorts out and disintegrates. This also burns up all of the attaching wires. Unit nearly catches on fire.

  - Technology ID: 330 - Circuit Breaker Switch Panels.
  - Technology Score: Score of 29 for the Air Compressor equipment type. Total score of 179 for all equipment types.

- Problem ID: 417 - Have fasteners that vibrate off (supposed to be captive).

  - Technology ID: 306 - Composite Vehicle Structure.
  - Technology Score: Score of 102 for the Air Compressor equipment type. Total score of 473 for all equipment types.

  - Technology ID: 337 - Thermoforming for Fabricating Lightweight Structural Composite Materials.
  - Technology Score: Score of 102 for the Air Compressor equipment type. Total score of 439 for all equipment types.

  - Technology ID: 358 - Thermoplastic Repairs by Bonding With Induction Heating.
  - Technology Score: Score of 102 for the Air Compressor equipment type. Total score of 439 for all equipment types.

  - Technology ID: 280 - Rigid-Rod Polymer Plastics for Structural Metal Replacements.
  - Technology Score: Score of 102 for the Air Compressor equipment type. Total score of 467 for all equipment types.

  - Technology ID: 198 - Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics.
  - Technology Score: Score of 102 for the Air Compressor equipment type. Total score of 439 for all equipment types.

- ◊ Technology ID: 36 - Advanced Composite (Thermoplastic) Repair for Aircraft Thermoset Material.
- ◊ Technology Score: Score of 102 for the Air Compressor equipment type. Total score of 439 for all equipment types.

- ◊ Technology ID: 188 - New Fiberglass Polymer Composite Using Lower-Cost Raw Materials.
- ◊ Technology Score: Score of 102 for the Air Compressor equipment type. Total score of 473 for all equipment types.

- ◊ Technology ID: 35 - Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts.
- ◊ Technology Score: Score of 102 for the Air Compressor equipment type. Total score of 473 for all equipment types.

- ◊ Technology ID: 202 - BFGoodrich's TempRite Low-Combustibility Thermoplastics.
- ◊ Technology Score: Score of 102 for the Air Compressor equipment type. Total score of 439 for all equipment types.

- ◊ Technology ID: 44 - Low Cost Composite Advances for Aircraft Structures (Graphite).
- ◊ Technology Score: Score of 102 for the Air Compressor equipment type. Total score of 489 for all equipment types.

- ◆ Problem ID: 1110 - The housing on the Davy LoPacs offers good accessibility but has too many fasteners which could create a FOD hazard. Consider use of a fiberglass housing. The sheet metal that is currently used is too thin and has a tendency to crack.

  - ◊ Technology ID: Same technologies as for Problem ID 417, above.
  - ◊ Technology Score: Same technology scores as for Problem ID 417, above.

A combination of Comprehensive Engineering Redesign and the application of selected technologies is believed to offer the best near-term solutions to the most severe problems in the Air Compressor equipment type.

5.2 Support Equipment Lessons Learned

The following Lessons Learned represent the SEEIT team's observations and opinions formed as a result of the five field visits. This information is not intended to provide policy guidance to SE managers, but merely to inform the reader of the nature and variety of problems with flightline SE. Some Lessons Learned may appear to be common knowledge and have simple solutions, however, the same problems seem to perpetuate year after year. Hopefully, the recognition of these problems will be the first step in resolving them.

1) The largest portion of the SE deficiencies are design-related, and generally would not benefit from technology solutions. Comprehensive engineering redesign (CER) is more appropriate for problem areas such as structural cracks, leaks, bad wiring, blown fuses, poor accessibility or usability, safety, and water intrusion into electrical parts. These problems are common to many pieces of SE.

2) With few exceptions, SE units seem to be designed with little regard to deployment footprint. Any serious effort to reduce the deployment footprint of SE would involve the use of multifunction support equipment. A modular approach using the same basic cart design for several different cart configurations with different functions would insure commonality of parts, particularly for engines.

3) Most of the rolling stock was not designed with deployment or efficient cargo loading in mind. Damage results to equipment when they are loaded or stacked in ways they were not designed to support. Heavy aircraft towbars are often stacked on the stairsteps of B-1 stands to save cargo floor space. B-4 stands receive abuse when they are loaded with heavy plywood boxes and C-1 stands. Engine transportation trailers are one of the few pieces of rolling stock that are stackable. One trailer is inverted, stacked on the other and secured with log chains. However, only limited use can be made of the internal space provided by this arrangement. Many pieces of rolling stock have fixed tongues, which may claim another half pallet of valuable floor space when loaded.

4) New maintenance stands are needed that can be taken apart for mobility purposes. Present stands also need better casters, caster brakes, side railings, support legs, stairs, pump jacks, and towability. Admittedly, maintenance stands are subject to heavy use and abuse which contributes to loose and missing fasteners. Maintenance stands are regarded as FOD generators.

5) The true reliability rate of SE can not be determined due to the absence of a simple hour meter to record total engine operating hours. Without this feature, only the repair dates can be retrieved, which provides no clear data for identifying failure trends before they become major problems.

6) The policy forbidding self-propelled SE on the flightline should be re-evaluated. Several pieces of SE are so heavy that maintainers are receiving back injuries pushing these units around. Several contractor prototype units, as well as commercial units, have newer self-propelled features that permit greater operator control, with slower speeds and no lurching. The contractors have demonstrated their units' ease of use and safety around parked aircraft. In fact, fighter aircraft at international airshows are now being ground handled and parked by self-propelled SE with towbars.

7) Deployment pack-up, marshaling and manifesting could use more computer automation, as paperwork processing is too slow and error-prone. Better methods of cargo tracking are needed to ensure faster off-load at the final destination, as well as better asset visibility during the transition from deployment to employment.

8) Defueling powered AGE in preparation for airlift deployment is very time-consuming, because the units do not have tank drains and must be siphoned. This problem appears to be a minor concern, but it is a continuing aggravation that wastes much time. It could be easily solved as a local modification.

9) Many maintainers want fewer hazardous materials called out in the repair manuals and more consistent instructions for their disposal. Many TOs are out of date, particularly with regard to EPA requirements. In some instances, the maintainers wanted the material to be packaged in smaller containers to minimize storage and disposal requirements.

10) Many SE control panels were designed in a manner that invites operator error. For example, failure to integrate the start/stop switches with the master switch will result in dead batteries whenever the master is inadvertently left on. Some electric fuel pumps are also switched separately and are often left on, which runs down the battery.

11) There were many complaints about cracked, crazed and unreadable gauges on flightline SE. This is further compounded by the fact that the whole gauge must be replaced, rather than just the lens. The troops complained as much about the cost of having to order the entire gauge as they did about not being able to read the gauge.

12) There is an over-abundance of electrical problems with many pieces of SE, such as wet circuit cards, bad wiring, fuses constantly blowing, bad regulators and poor battery charging resulting in blown fuses due to jump starting. Dead batteries are a universal complaint heard from all areas of the flightline, particularly during the summertime. The Christie battery charger is universally acclaimed as too old: it doesn't charge properly and it is too hard to get replacement parts. The maintainers say it should be replaced now.

13) Corrosion plagues nearly every piece of SE on the flightline. It particularly affects enclosures, which have corners and crevices that must be sanded and repainted in full suit, even for spot painting. The USN has recently developed special paints and corrosion inhibitor coatings for their SE that should be investigated, along with selective application of composite materials.

14) There were many complaints that some SE does not meet its single-function, minimum performance requirements. The maintainers state (arguably, perhaps) that H-1 heaters do not heat adequately, although heating is its sole function. The C-10 air conditioners do not cool adequately, although cooling is its sole function. The aggravation factor increases as there are no other pieces of SE to substitute for these functions. The AGE maintainers often state that the users have unreasonable expectations from the SE, or that the users are not adequately trained in correct unit operation (user abuse). The issue is obviously larger than that. Basic performance standards are not being met.

15) For several types of SE, over half of the reported failures are felt to be operator induced. Maintainers characterize the MJ-2A hydraulic test stand as the hardest to operate and the most complicated piece of SE on the flightline. The replacement unit should address this fault.

16) The most common complaint about diesel engines (other than excessive vibration) was that the glow plug coils often break and the pieces go down the intake, causing valve damage. Troops stated that this happens on all diesel engines. This appears to be a very expensive problem, as the engine damage is usually extensive enough to require a new engine.

17) Accessibility for routine maintenance was a common complaint. There were numerous instances of lubrication ports that were hard to service, hard to reach oil filters, easily cracked filter housings, difficult to access batteries, and major teardown of enclosures to change out peanut bulbs and meters.

18) Lack of spare parts is a problem for many pieces of SE. Generally, the piece of SE was either obsolete or the manufacturer went out of business. However, defective new parts were also an issue with the AGE maintainers. Leaking radiators and water pumps from base supply for the -86 generator have become so common that in-shop testers have been fabricated to test them before installation.

19) Printed instructions on many of the SE units get worn and unreadable. This is a particular problem for SE units that are used only infrequently. In less than 4 years, the typeface on labels under knobs and gauges was worn off on the MJ-2 hydraulic test stand. The usability of the MJ-2 could also be improved by color coding or marking the six hydraulic hoses, as instances were cited of the MJ-2 being hooked up with crossed hoses. Some SE units do not have panel lights, which hinders night maintenance.

20) It is still a common complaint that it takes too long to get corrective actions through the system. Many simple suggestions are turned down for "desktop reasons". If a more thorough "hands on" investigation of the feasibility of implementation was required for disapproval, perhaps more suggestions would be adopted. The relocation of the starter solenoid on the MJ-1 jammer was a simple, low cost (and effectively proven) solution to the hard starting problems and blown fuses during hot weather. The suggestion was disapproved, with the MJ-1 still awaiting an approved solution.

21) Loose and missing fasteners are still a common complaint for all SE, but particularly for C-1 maintenance stands. Engine vibration is blamed for the missing fasteners on the MC-2A compressors, LiteAlls and -86 generators. Many good self-locking fasteners are now on the market.

22) Fuel shop technicians complained there is not a good way to troubleshoot external fuel tanks. They reported the Universal Fuel Tank Certifier as totally unsatisfactory and that a new tank certifier should be designed from scratch.

23) AGE maintainers want better parts from supply, better parts availability for the older units, better fasteners, and the authority to locally purchase common hardware. It was felt that the tech orders were too restrictive in regard to the local purchase of general hardware, such as hinges and latches, and should be permitted if it meets or exceeds the original standard.

24) When technical orders authorize certain items to be locally manufactured at the base level, the drawings should be included in the tech order. A lack of drawings creates a problem. A filler cap gauge was one of the examples provided.

25) The reliability and resupply of hand tools are greatly improved when the tools are contract purchased from well-known national vendors. The tools are guaranteed for life and the company provides on-base service in the same manner they service their commercial customers.

26) The field reported that because nitrogen can be used for all applications of high pressure air, all high pressure compressors could be replaced with a good nitrogen system. The technology exists to convert an existing HighPac compressor into a nitrogen generator by incorporating a hollow fiber membrane module. The output is a constant supply of dry, gaseous nitrogen. This concept was used by US Army helicopters during Desert Storm and is used by the USAF at Andrews AFB, Md.

5.3 Supportability Design Influence

During the development of a new weapons system, such as fighter aircraft, one of the objectives specified to the defense contractor is designed-in supportability. This ensures that the required operational and utilization rates will be met, and the life cycle costs of both the air vehicle and its support system will be reduced. The process of designing for supportability begins early in the CE&D phase, with reviews and studies directed at identifying the operational requirements of the weapons system. This information is augmented with Lessons Learned data, experience gained on other programs, as well as customer input, to establish supportability-related criteria to be addressed by the engineering community. This procedure is called Supportability Design Influence (SDI), and is an automated, workstation-based process at Northrop Grumman. The program manager places responsibility for achieving a supportable design on the product teams, and accountability rests with both the chief engineer (and thus the individual design engineers) and the RM&S manager (and thus the RM&S system engineers). RM&S system engineers develop the supportability requirements, assess the design, and track progress against these requirements. In this way, the supportability design activity is integrated with design engineering and other disciplines throughout the task team process.

Since the SEEIT database is a relational, PC-based program, it could be easily used in a like manner for SDI during the development phase of new support equipment. This would provide a standardized method for the centralized collection, dissemination and accountability of designed-in supportability features and characteristics during the design phase of SE. Additionally, the problems and deficiencies portion of the SEEIT database should be used as additional input and given to the appropriate design engineer to assure that existing SE problems will not reoccur in his portion of the new design.

The following is a starter list of SDI features and characteristics for future SE that were garnered from the base visits:

1) AGE maintainers want better access on every unit they work on. Even the routine maintenance is hindered by hard-to-access batteries, oil filters, peanut lights, etc. The ease of engine change-outs also needs to be improved.

2) New SE should have some degree of multifunction capability. Single-function SE has produced a proliferation of separate engines and hardware that is difficult and costly to support. Apart from the supportability issue, single-function SE is very unsuitable for mobility purposes, and places an undue strain on valuable airlifter resources. Informal feedback from the field indicates that a combination of electrical power, lighting, and ECS air would be the most useful piece of equipment.

3) All SE users and maintainers want more input into the design and evaluation of replacement units. First-hand accounts were heard about evaluating test articles in the field, but the field-recommended unit was not selected for procurement.

4) SE units must be designed with mobility in mind. This involves such features as being stackable, nestable, easier to disassemble and assemble, and have a smaller footprint. Examples include snap-together maintenance stands, better use of internal storage space for deployment, drainable fuel tanks, and adequate ramp clearance for airlifter loading.

5) For any large or heavy unit being developed, a self-propelled feature should be seriously considered. It is not uncommon to manually move or reposition SE units on the flightline to expedite maintenance. This exuberance often results in serious back injuries. Today's commercial controls have improved to the point that their safety and controllability are beyond reproach.

6) Better fasteners are needed because they often work loose and become a FOD hazard on the flightline. Zeus fasteners are particularly despised because they pop open, and their captive feature eventually fails. Loose and missing fasteners is a common complaint for all SE.

7) SE users want SE to be simpler and easier to use. Operator error, as well as abuse, originates with equipment that is hard to operate. Simple troubleshooting instructions on a placard was mentioned as a way to improve usability.

8) Better resistance to corrosion should be a prime consideration. Enclosures that have nooks and crannies provide places for water entrapment. Better paints and corrosion inhibitors are needed. Composite enclosures should be considered as part of the solution.

9) SE power generation requirements for military aircraft are not clearly understood by equipment developers. Each new version of SE seems to have larger engines than the previous models to ensure that peak loads are met. Horsepower "creep" has become the design approach for the next model, although it is rarely operated at those extreme levels. This HP spiral for the prime movers is also perpetuated by the desire to develop SE with the widest aircraft application. This design approach results in the engine not running at optimum efficiency, causing excessive fuel consumption and premature wear.

10) Basic engine designs have not been changed significantly to meet pending environmental emissions standards. Other problems continue to plague today's engines, such as voracious fuel consumption, glow plug breakage, wet stacking, erratic shutdowns (sometimes setting themselves on fire), excessive vibration, and exhaust leaks. Current engine designs need a great deal of improvement in order to prevent these problems in the next generation of SE.

11) New SE should consider maximizing its parts commonality with existing SE to improve the overall supportability of the SE inventory. Examples include oil filters, fuel filters, wheel and tire sizes, batteries, engines, fuel pumps, water pumps, radiators, bearings, brake linings, gauges/meters and lens assemblies, fasteners, hoses and belts, lightbulbs, etc.

12) AGE maintainers want some degree of self-test diagnostics/BIT on the more complex units to enhance its maintainability. Over-design of an onboard BIT system is a concern as they can create more problems than they solve. However, a ruggedized, simple-to-use diagnostic system which troubleshoots electronic modules and complex control systems would greatly reduce repair times for these types of higher-order failures.

13) The requirement for PMEL calibrations should be minimized. Too much downtime occurs when these items must be scheduled into the Lab. Self-calibrating units or development of user calibration methods would be preferred. Another factor in this equation is the users' desire to be more self-reliant (it is always faster to fix it yourself than to rely on someone else).

14) Inadequate bin size for hose storage on generators and air conditioners creates problems. These hoses, which range from 25 to 30 feet long, are eventually cut down to shorter lengths so that they stay in the bin instead of falling out when the unit is towed. The next complaint heard is that the hoses are too short to reach the aircraft .

15) Many users want lightweight towbars on the maintenance stands. For the stands that are presently towable, the casters are a problem because they wear out too soon and shimmy violently, even at slow speeds. The foot-operated, coaster brakes are troublesome because they fall down and lock by themselves, particularly while under tow, and have to be wired up. The teeter-totter style brakes aren't effective either as they do not stay locked.

16) Fuel tanks are an issue. Larger fuel capacities result in fewer aircraft maintenance jobs being interrupted to perform the mundane chore of refueling. Refueling means unhooking the cart from the aircraft, and waiting unproductively at the aircraft until the unit is returned from the refueling pad. Better fuel venting is needed to prevent spillage during refueling. For units with small filler necks, a sight gauge would prevent overfill/spillage. Fuel gauges are commonly known to be inaccurate.

17) Several comments were made about the questionable accuracy and readability of the analog gauges for frequency and voltage on generator units. Digital readouts were thought to be more accurate and easier to read, with fewer lenses crazing in the sunlight. Analog meters are still preferred for setting pressures, such as flowmeters and pressure gauges.

18) Surprisingly, a vacuum cleaner was mentioned by the field as the most desired feature they want added to a new piece of support equipment. Aircrews frequently write up the aircraft for having FOD in the cockpit. A vacuum cleaner with a slender nozzle could reach around and under the ejection seats to extract small debris. A simple venturi tube nozzle with a collection bag attached to a compressed air hose would provide the necessary vacuum.

19) Many of the air compressors were cited as having problems with moisture entering the compressor oil, particularly in humid climates. This necessitates filter change-outs, and draining and flushing of the units. When air is compressed, a certain amount of water will condense from the worked air, but the exact cause of the water entering the oil remains unknown. One maintainer thought it was because the dehydrator was located at the end of the system. Sometimes the separator pads clog, which causes the unit to spew oil. Future SE designs should address improved methods of water separation and extraction.

20) Air cycle machines (C-10 air conditioners) are experiencing expansion turbine failures due to water condensation in the oil. During high humidity, the coalescent bag will freeze up. One suggestion was to install a screen in front of the coalescent bag to break up the moisture droplets before they enter the coalescent bag and clog it up. Future designs should investigate additional solutions.

5.4 Recommended Research Candidates

During the Quality Function Deployment (QFD) process of Task 4, the SEEIT team prioritized the potential solutions for each equipment type and, in the process, identified several technologies as prime candidates for further research. These technologies range from new concepts to completely replace existing problematic AGE/SE, to the research/development of improved fastener technology. Based on their potential to eliminate a broad spectrum of AGE/SE problems, the following technology categories are recommended for further research and development to achieve optimum solutions to existing problematic equipment and/or improving new and emerging equipment:

1. Unit Replacement Technologies (Total Systems or Derivatives of Total Systems)
2. Prime Mover Technologies (Engines or Other Power Sources)
3. Composites Technologies (Enclosures and Structures)
4. Battery Technologies (Electrical Power Storage)

Unit Replacement Technologies
These technologies are **system level** concepts and existing products which could potentially replace one or more pieces of problematic AGE/SE. The concept in unit replacement is to eliminate all problems associated with a particular piece of AGE/SE by replacing the entire unit. Potential unit replacement technologies are listed in Figure 5-1.

Tech ID	Technology Description	Technology Scores						
		Gnd Pwr	Gen SE	Air Comp	Hyd Eqpt	Air Cond	Deploy ment	Aux Lights
1	MAGSS Multifunction Cart - 7 function	211	108	160	209	151	30	171
298	Hepp Vapor Engine Modular Service Cart - 7 function	218	106	168	209	159	30	171
300	Portable ECS (PECS) - 1 function	--	--	--	--	159	--	--
282	Whisper Ground Power Unit - 1 function	276	--	--	--	--	--	--
299	Multifunction Unit for Hyd, Air and Elect - 3 function	--	--	71	63	--	--	--

Figure 5-1. Potential Unit Replacement Technologies

Considerations

Three of the technologies listed above in Figure 5-1 involve service carts which have multifunction capabilities. The multifunction approach to aircraft ground support equipment addresses two key issues that hinder Air Force logistics: deployment and R&M. For home base operations, the greatest flexibility is provided by single function carts which are usually provided in sufficient quantities to meet most maintenance recovery demands. However, the deployment of such a large collection of flightline SE requires 64 percent or more of the allotted airlifter resources, which most authorities consider excessive. The reliability of some of the lesser used single function carts suffer as a result of dead batteries, hard starting engines, rusty brakes that don't release, oil leaks and flat tires. Additionally, the large number of individual engines in each piece of single function SE makes for a large and costly maintainability burden. Commonality of components is further reduced by single functionality because of the different engines and ancillary components, which in turn, requires a wide variety of spare parts and technical manuals. The inherent characteristics of the multifunction approach addresses both the deployment issues and the R&M issues.

The Multifunction Aircraft Ground Support System (MAGSS) is an example of a multifunction cart that exists today. The diesel powered unit provides 7 servicing functions (electrical power, engine start air, environmental cooling air, dual hydraulic power, compressed nitrogen, compressed air, and floodlighting). The MAGSS has been successfully field tested at several Air Force bases, which has proven the validity of the multifunction concept. It has been recently marketed and sold internationally to several overseas customers wishing to reduce the amount of SE on their flightline. The MAGSS is an excellent example of the capability and flexibility that is inherent in a well-engineered multifunction unit that is available today, with virtually no risk or development costs.

The Hepp Vapor Engine Modular Service Cart, by contrast, is a concept for a modular multifunction SE unit which utilizes high pressure, superheated water vapor as the power distribution bus. The vapor engine concept offers unique advantages that are not possible from present-day internal combustion engines, such as extremely low emissions, multi-fuel compatibility with nearly anything that is liquid and combustible, virtually no generation of

noise, high reliability due to an extremely low parts count, and ease of starting in severe sub-zero weather. The steam generator produces power to provide electrical power (AC/DC), environmental heating and cooling (air or PAO), night area illumination, hydraulic power, compressed air, compressed nitrogen, pneumatic engine starting, cleaning and decontamination, deicing and a capability for light towing. The risk of the vapor engine concept is very acceptable, as steam power and the involved thermodynamics have been very well understood by the commercial sector since the 1930s. Though these older designs worked very well during their time, properly integrated state-of-the art electronic controls, sensors and modern materials will maximize the thermal management efficiency of the vapor engine for any throttle setting or power demand.

Several variables must be kept in mind when considering a new unit replacement. New SE with a multifunction capability provides more efficient utilization with smaller deployment footprint, but this must be reconciled with the increased costs of introducing new technologies. The individual replacement cost of existing SE may appear appealing when compared to a new multifunction unit. However, the recurring cost of maintaining a fleet of older technology SE with its multitude of reliability and usability problems is not trivial.

Any new unit replacement must be evaluated against the subsystem requirements of the advanced technology aircraft that will be fielded within the next decade or so (the F-22 and Joint Strike Fighter). In some cases, the subsystem upgrade of an existing aircraft, such as the F-15E environmental cooling for avionics, requires more support capability than existing SE can reliably provide. New SE must meet these demands and be readily capable of future growth, whether through simple modification or a derivative upgrade.

Survey comments indicated that some existing problematic SE will be phased out with no planned replacement, such as the -85 Generator/GPGS. However, other SE units will be upgraded by a new derivative, namely the NF-2D LiteAll. Unfortunately, the corrosion, excessive vibration and cracking generator fields appear to not have been corrected. Even for a derivative design, current deficiencies and user suggestions should be reviewed to ensure that existing problems and weaknesses are not carried forward. The automated SEEIT database should be used as a checklist during the assessment of derivative SE, as well as for the development and manufacture of new AGE/SE.

Prime Mover Technologies

The SEEIT Program identified several potential prime mover technology candidates that could be of benefit to current and future AGE/SE. Listed below are the technologies identified thus far. However, it should be noted that there are additional prime mover technologies that could be added to those shown in Figure 5-2.

Considerations

Prime movers on today's flightline have been largely converted to diesel engines, with only a few gas turbine (and fewer gasoline) units remaining. Diesel engines deliver good fuel economy

and service life, but their vibration and noise levels are high and they suffer from hard starting. The fuel economy of diesels is limited under off-speed or off-power conditions, and it is unclear if their toxic emissions will meet future environmental air quality standards.

Tech ID	Technology Description	Technology Scores						
		Gnd Pwr	Spec Purp	Air Comp	Hyd Eqpt	Lift Truck	Tow Truck	Aux Lights
298	Hepp Vapor Engine*	218	--	168	209	--	--	171
302	Split Cycle Engine	60	49	53	35	--	24	44
136	High Efficiency Propulsion System	53	41	53	35	--	19	36
317	Lighter Cast Iron Engine Blocks	1	--	6	1	1	1	7
309	Electric Vehicles	--	--	--	--	195	46	--

* The Hepp Vapor Engine scores were extrapolated from Figure 5-1, Potential Unit Replacement Technologies. These values more accurately reflect entire unit replacement scores, not just the prime mover.

Figure 5-2. Potential Prime Mover Technologies

Gas turbine engines have a higher power-to-weight ratio, but are 5 to 10 times more expensive and are more inefficient for smaller applications with no corresponding increase in service life.[2] The noise levels of gas turbines are excessively high, as are the exhaust temperatures and emission levels. They have appreciably higher operating costs than either diesel or gasoline units because of the gradual degradation of the turbine blades due to the ingestion of particulates and off-power inefficiencies (there is no idle). It has been a difficult engineering challenge for industry to design an efficient gas turbine engine for small power applications, such as flightline SE.

Though prime mover technologies were not identified as high priority solutions to specific AGE/SE problematic equipment, the field survey documented restrictive engine problems, to varying degrees, against every piece of powered SE on the flightline. These problems ranged from hard starting, cold temperature starting, excessive vibration and noise, and wet stacking, to periodically setting themselves on fire. New, innovative prime mover technologies for SE could have a significant impact on today's operational and logistical problems concerning rapid deployment, mobility footprint and poor reliability. Better fuel consumption, lower level of complexity, and lighter weight prime movers would provide the greatest overall benefit to today's AGE/SE performance.

The vapor engine concept was the only technology found that offered significant advantages over internal combustion engines. A modern vapor engine will convert the steam energy efficiently into work over a wide range of operating speeds, while producing virtually no noise, vibration or emissions. An electronic ignitor will provide rapid firing with warm-up time less than one minute in subzero weather. A low parts count, coupled with simplified operator controls

[2] "Technology Options for Modular Ground Support Equipment", Battelle, October 1996

(such as opening a steam control valve to start an auxiliary drive) will promote exceptional reliability while eliminating operator error and damage. Much of the electrical wiring and ignition problems of today's powered SE will be avoided, as very little of it exists on a vapor engine. No clutches, transmissions or gearboxes are needed, or supporting substructures and mountings, which reduces weight and saves internal space of the service cart. With only fuel and water to drain (no coolant or lubrication systems exist), the unit can be designed to tip on its back for even more footprint savings. The vapor engine concept is a viable candidate for a flightline service cart, particularly if it were designed as a multifunction unit. The technology cannot be retrofitted to existing support equipment as every piece and part is unique to the vapor technology. However, this technology should be developed with the intent to produce a family of support equipment to maximize its inherent utility. Several years of basic research have been completed on the suitability of the vapor engine technology for electrical power generation. With proper funding, a working prototype could be designed and produced within 3 years. Only component sizing and engineering drawings of sufficient detail are needed before "cutting metal" can start for the prototype.

Composite Technologies

The SEEIT Program identified a large number of composite technologies that could potentially solve certain AGE/SE problem areas and improve certain operational aspects of AGE/SE. A representative selection of composite-related technologies are listed in Figure 5-3.

		Technology Scores						
Tech ID	Technology Description	Gnd Pwr	Gen SE	Air Comp	Hyd Eqpt	Air Cond	Deploy ment	Maint Stand
35	Advanced Resin Transfer Molding	57	30	102	21	51	24	148
36	Adv. Composite (Thermoplastic) Repair for Aircraft	57	30	102	17	51	--	148
44	Low-Cost Composite Advances for Aircraft (Graphite)	57	30	102	21	51	24	164
188	New Fiberglass Polymer Composite	57	30	102	21	51	24	148
197	RF-120 Thermo Composite Material	--	--	--	--	--	2	--
198	Antimony Oxide Flame Retardant for Composites	57	30	102	17	51	--	148
202	"Temprite" Low Combustibility Thermoplastics	57	30	102	17	51	--	148
268	Composite Repair Technology for Metallic Structures	0	0	0	--	0	--	0
280	Rigid-Rod Polymer Plastics for Structural Metal	57	30	102	21	51	24	148
306	Composite Vehicle Structure	57	30	102	21	51	24	148
337	Thermoforming for Lightweight Composite Materials	57	30	102	17	51	--	148
358	Thermoplastic Repairs With Induction Heating	57	30	102	17	51	--	148

Figure 5-3. Potential Composite Technologies

The major areas of potential benefit to AGE/SE are as follows:

1. Composites will minimize rust and corrosion conditions resulting from exposure to moisture created by the item itself and/or exposure to the environment. Reduced maintenance and improved availability will result from the application of composite structures for AGE/SE housings and enclosures. In some cases, noise attenuation and vibration may also be improved through the use of composite materials for both acoustic treatment and enclosure structures.

2. Composite structures for AGE/SE enclosures and housings will likely reduce unit weight without compromising structural integrity. A reduction in weight could be beneficial to those equipment items that are difficult to move or maneuver. Improvement to unit weight enhances mobility and improves deployability.

Considerations

The technology area of composites encompasses an array of materials and processes. In most cases, the application of composite technology to AGE/SE problems ranked as a second or third level priority due to the uncertainty associated with risk and cost. Further cost/benefit trade analyses are recommended on the application of composite technology to problematic AGE/SE. Specifically, those AGE/SE items having the largest number of problems, especially with corrosion and maneuverability, should be addressed first. Equipment items under consideration or planned for replacement should be excluded from these analyses.

Further research and development of all the composite technologies listed below is recommended, rather than a specific technology contained within the group. If a general feasibility assessment indicates merit in composite-based solutions, specific composite types can be assessed for the best application and maximum benefit.

Battery Technologies

A significant number of battery-related problems were identified for AGE/SE across the full spectrum of equipment. It is readily apparent that those AGE/SE items that have batteries could greatly benefit from improved battery technologies. Also, the lack of battery cell interchangeability among the different brands often has a negative impact on AGE/SE availability. The battery-related technologies listed in Figure 5-4, below, have been identified in the SEEIT Program. Due to the types of battery-related problems that were amassed during the field visits and the absence of any detailed design information for each new battery technology, all batteries were scored nearly identically.

Though not illustrated in Figure 5-4, the Reduced Maintenance Batteries (Tech ID 27) was the only battery technology that was awarded a score of 21 in the Auxiliary Lighting equipment type category. The reason for the slight difference in scores is attributed to the internal protection devices contained in the Reduced Maintenance Batteries, which should provide adequate protection against the voltage regulator problems associated with the NF-2D LiteAll. As mentioned earlier, all technology assessment scores can be easily viewed in the "Technology Analysis" section of the automated SEEIT database.

Tech ID	Technology Description	Technology Scores						
		Gnd Pwr	Gen SE	Air Comp	Hyd Eqpt	Lift Truck	Environment	Misc Shop
27	Reduced Maintenance Batteries	10	18	18	18	22	26	121
78	Lithium Solid Polymer Electrolyte Batteries	10	18	18	18	22	26	121
133	All Plastic Battery	10	18	18	18	22	26	121
155	High Reliability Maintenance Free Battery	10	18	18	18	22	26	121
233	Solar Power to extend Battery Life (Solargizers)	10	18	18	18	22	26	121
238	All Plastic Solid State Battery	10	18	18	18	22	26	121
346	Low Maintenance Battery System for Aircraft	10	18	18	18	22	26	121
364	Two-year Batteries for Aircraft	10	18	18	18	22	26	121

Figure 5-4. Potential Battery Technologies

Considerations

Though many SE units have been converted from lead acid to the newer gel battery system, flightline feedback indicates the gels have problems of their own. Cold weather cranking power is lacking and the cells are not interchangeable from one brand to another. Even with the newer gel batteries, failures were a major headache during the hot summer months. The short duty cycle of many pieces of SE (perhaps 10 minutes or less) is not long enough for a complete recharging. Voltage regulators were reported as a contributing factor to battery failures due to weak transistors and diodes. A poor onboard recharging system on the -86 Generators and NF-2 LiteAlls further compounds the dead battery problem. Coupled with poor battery accessibility, this maintenance problem becomes a major year-round aggravation for the maintainers.

The US Armed Forces have long recognized the need for better battery technologies. Dead batteries have continually plagued military units' readiness, not to mention the efforts and costs involved in their replacement and disposal. At present, the business of supplying battery replacements to DoD agencies is a lucrative one. During 1995, the US Army alone spent $77.2 million on 300 different types of batteries.[3] Though not invented yet, the ideal battery would be composed of non-toxic materials, be infinitely rechargeable, and possess none of the weight, safety, and environmental concerns associated with metal-based batteries. While lacking the ideal battery, the Army is involved in a number of initiatives to reduce battery-related expenditures. It is awarding contracts which are moving toward maintenance-free vehicle batteries and buying inexpensive battery testers.

[3] Armed Forces Journal International, Aug 1996, pg. 18

At Fort Hood, Texas, a major testing effort is underway using Solargizers.[4] This is a small, inexpensive device that uses solar power to extend battery life up to five times what is normally experienced. The Solargizer extends battery life by converting sunlight (or AC power) to a low power pulse charge that ends the process of sulfation in batteries. Sulfation occurs as a battery loses its energy through discharging, allowing a crystallized sulfate formation to build up on the battery's lead plates. Using the same principle as the Solargizer, modified transformers and circuit boards (powered by either a 115V or 220V AC power source) can maintain batteries installed in vehicles stored in shelters or otherwise out of direct sunlight. Tentative results have been very promising.

Further investigation into the area of electrical power storage should be conducted to expand the database of available information. Battery technology is a rapidly expanding field of research that makes announcements of major advancements several times a year. New and promising technologies should not be overlooked in this emerging field of research.

5.5 Future Database Application

Because the automated SEEIT database was developed as a relational database using Microsoft Access, it has virtually unlimited growth potential to incorporate newly-developed data tables that can be easily added and linked to the existing tables. This allows for easy expansion into a broad spectrum of related activities, which may include simulation modeling, SE deployment studies, aircraft R&M analysis, SE utilization studies, and tracking SE lessons learned or new SE design features.

The support equipment Product Improvement Working Group (PIWG) could use the database via the Internet to receive, track and document SE-related problems from the field. This would provide an excellent foundation for the PIWG to identify recurring problems and develop an AGE/SE historical database. SE problems, field-recommended solutions, disposition of specific problems, and the schedules of projected fixes could easily be added to the current database. Additionally, the SEEIT database provides a worthy platform for the dissemination and exchange of new design concepts, new/emerging technology applications, proposed changes to an item's maintenance or support concept, and re-emphasis of commonly violated or unknown cautions and warnings.

Aircraft Reliability and Maintainability data may also be made an integral part of the database. A sampling of A-10 historical R&M data was included as a demonstration of the database's growth potential, and can be accessed via the Main Switchboard. Embedded in this feature is the ability to link the support equipment items required to perform aircraft maintenance at the three-digit work unit code level (subsystem level). Information of this nature is particularly useful for determining SE utilization factors, performing aircraft comparisons and analyses, and developing

[4] PulseTech Products Corporation, as reported in Armed Forces Journal International, Aug 1996, pg. 18

simulation modeling capabilities, including the identification and consumption of support resources.

Another excellent future application of the SEEIT database would be a lessons learned and design influence program for newly-designed SE items. As noted in Section 5.3, the database can be easily modified to provide a standardized method for the centralized collection, dissemination and accountability of designed-in supportability features and characteristics during the design phase of future SE items. The problems and deficiencies portion of the SEEIT database is an ideal tool for additional input and dissemination to the appropriate design engineer to assure that existing SE problems will not reoccur in their portion of the new design.

The SEEIT database is also well suited for supporting specially-focused projects such as deployment/deployability studies. The database has been designed to allow the possible future inclusion of support equipment tables of allowance for a variety of aircraft. When coupled with force deployment information, such as that developed for the F-16 and illustrated in Appendix 7, a powerful yet extremely flexible analysis and documentation tool is easily created.

Section 6.0
SEEIT Database Development

6.1 Relational Database Using Microsoft Access

The goal of the SEEIT database is to effectively manage large amounts of data, thereby permitting the user to gain insight into the data. A relational database can most effectively accomplish this goal. A thorough understanding of relational database concepts was necessary for the development of the SEEIT database. Through the implementation of relational database concepts, data can be normalized into smaller sets of data that contain and represent objects, allowing more data to be imported later and more relationships to be formed. All of the underlying complexity of the database is transparent to the user.

Microsoft Access was selected for this project simply because it is the best desktop database available for the PC. MS Access is part of the Microsoft Professional Office, which includes MS Word, MS PowerPoint, MS Mail, and MS Excel. Microsoft has integrated these products into an environment that allows data to be exchanged relatively easily through Object Linking and Embedding (OLE) automation. Version 7.0 of MS Access provides even more integration by providing a common language, Visual Basic, for all of the Office components.

MS Access has the capability to bring data in from a variety of other databases such as Dbase, Paradox and Fox Pro that reside on the PC, as well as the capability to interact with larger mainframe databases such as Oracle. Additionally, MS Access can import tables from MS Excel and MS Word. Once this information has been imported into MS Access and normalized, a graphical tool allows the developer/user to define relationships between tables. In this manner a relational database can be developed and the data can be managed effectively.

MS Access also has the capability to create impressive forms and reports. MS Access provides many different types of controls and utilities that allow the user to represent and process data in many different ways. Charts can be created in Access and embedded in MS PowerPoint, MS Excel, and/or MS Word. When the data in the database is updated, the information in the report will also be updated if the user desires. Reports can be formatted and exported directly to MS Word.

With the addition of the Access Developer's Toolkit, a run-time version of the database can be created that does not require the user have MS Access on their computer.

With the Access Internet Assistant, an on-line version of the database can be created that can be accessed remotely, via the Internet. This product is free from Microsoft and can be downloaded directly from Microsoft. Varying levels of protection can be applied to any on-line version of the SEEIT database to ensure information integrity and security.

6.2 Architecture

Inputs

Inputs to the database include:

1) Problem areas and deficiencies relating to support equipment with regard to usability, reliability, maintainability, supportability and deployability, as well as any administrative and safety issues or general comments which were reported during the numerous USAF operational base visits.

2) A portion of MIL-HDBK 300 Support Equipment Characteristics Data (much of which was imported from the COLORS database developed by Computer Sciences Corp. (CSC) and provided by Armstrong Laboratories).

3) Background information from the military personnel (AGE/SE users, maintainers, etc.) that were interviewed.

4) Selected photos of AGE/SE taken during USAF operational base visits;

5) Potential solutions and near-term/emerging technologies, and data relating these technologies to the problem areas and deficiencies.

6) Results of the Technology Assessment, including scores for each of the Problem Impact Areas, scoring rationale, and Risk/Cost assessments.

Process

Data imported from the COLORS database was found to be somewhat inconsistent and in need of normalization. The data was separated into two main tables and other smaller tables which related the two together and enhanced the normalization. The manufacturer data was normalized for every CAGE code and the AGE/SE characteristics data was normalized for each NSN. The normalization process was a time consuming but necessary step.

The problem areas and deficiencies data was keyed by the interviewers into MS Excel and MS Word. The data was then imported into the SEEIT database and normalized with a common naming convention that was developed to link it to the SE characteristics data.

The personnel background information from the field interviews was also keyed in as part of the SEEIT database, and can be furnished upon request by the Program Office.

Finally, photos were scanned in and technologies were imported from MS Word. These technologies were subsequently linked to equipment types and problem areas, and all necessary intermediary tables and assessment results tables were created. The tables were then populated as the individual assessments were performed and data became available.

Relationships

Once the tables were populated with data, relationships among them were formed graphically using MS Access. The integrity of the data is defined and maintained by these links. Redundant data is eliminated and error propagation is minimal. Figures 6-1 and 6-2 show the Relationship Windows for the SEEIT Database. Each box within the diagrams represents a table of data, while the lines between the tables depict the relationships. Each of the relationship lines has a

value at each end which defines the relationship between the tables, such as a "1" and a "1", or a "1" and an infinity symbol , "∞". The first pairing denotes a "one-to-one" relationship between two tables while the latter signifies a "one-to-many" relationship, meaning that for every record in the table on the "one" side there could exist many records in the corresponding table on the "many" side. For example, the table "tblManufacturers" has a one-to-many relationship with the table "tblMain". This is due to the fact that one CAGE Code could have a list of multiple NSNs. Within each box is a list of the field names for the table, with the bold-faced field name representing the primary key of the table (i.e. the unique identifier for the record). The primary key prevents duplicate records from being entered into the tables.

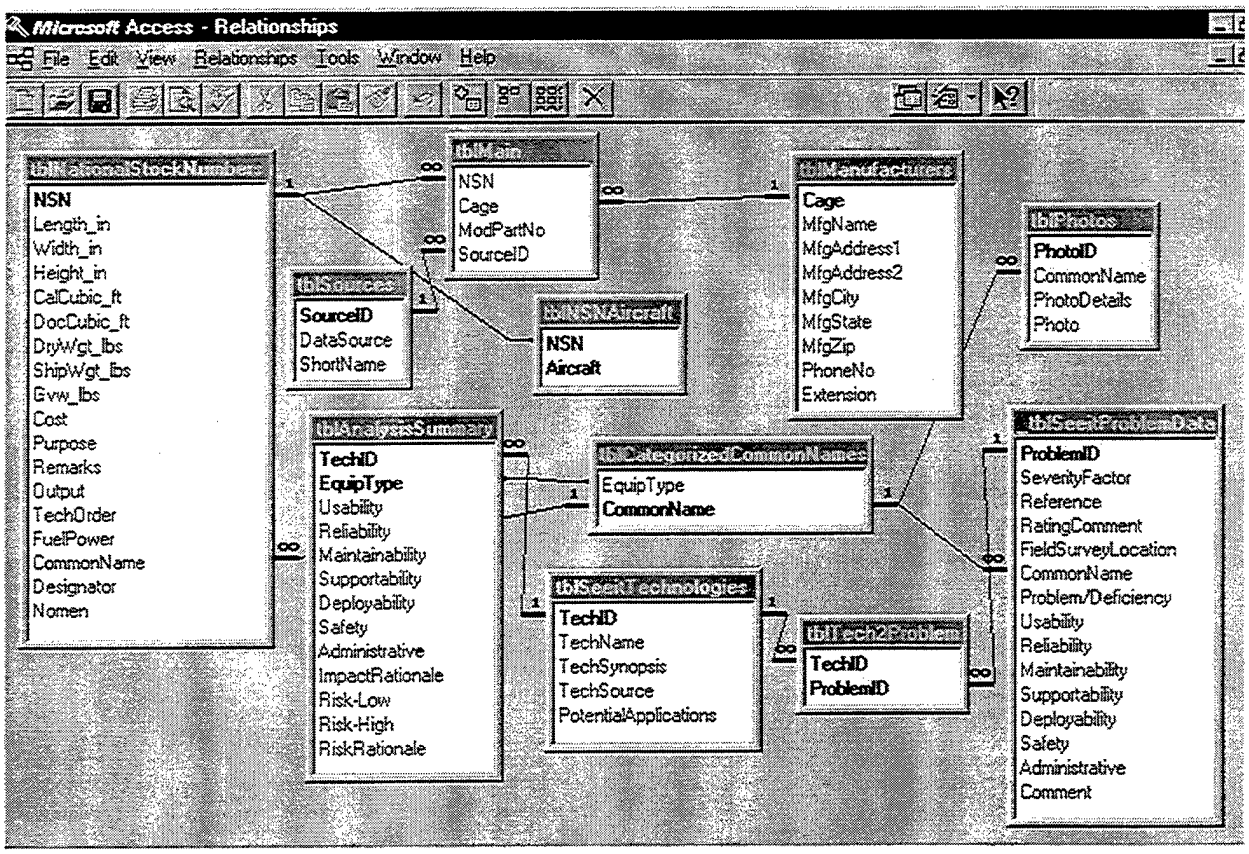


Figure 6-1. Graphic Relationship Diagram Part One

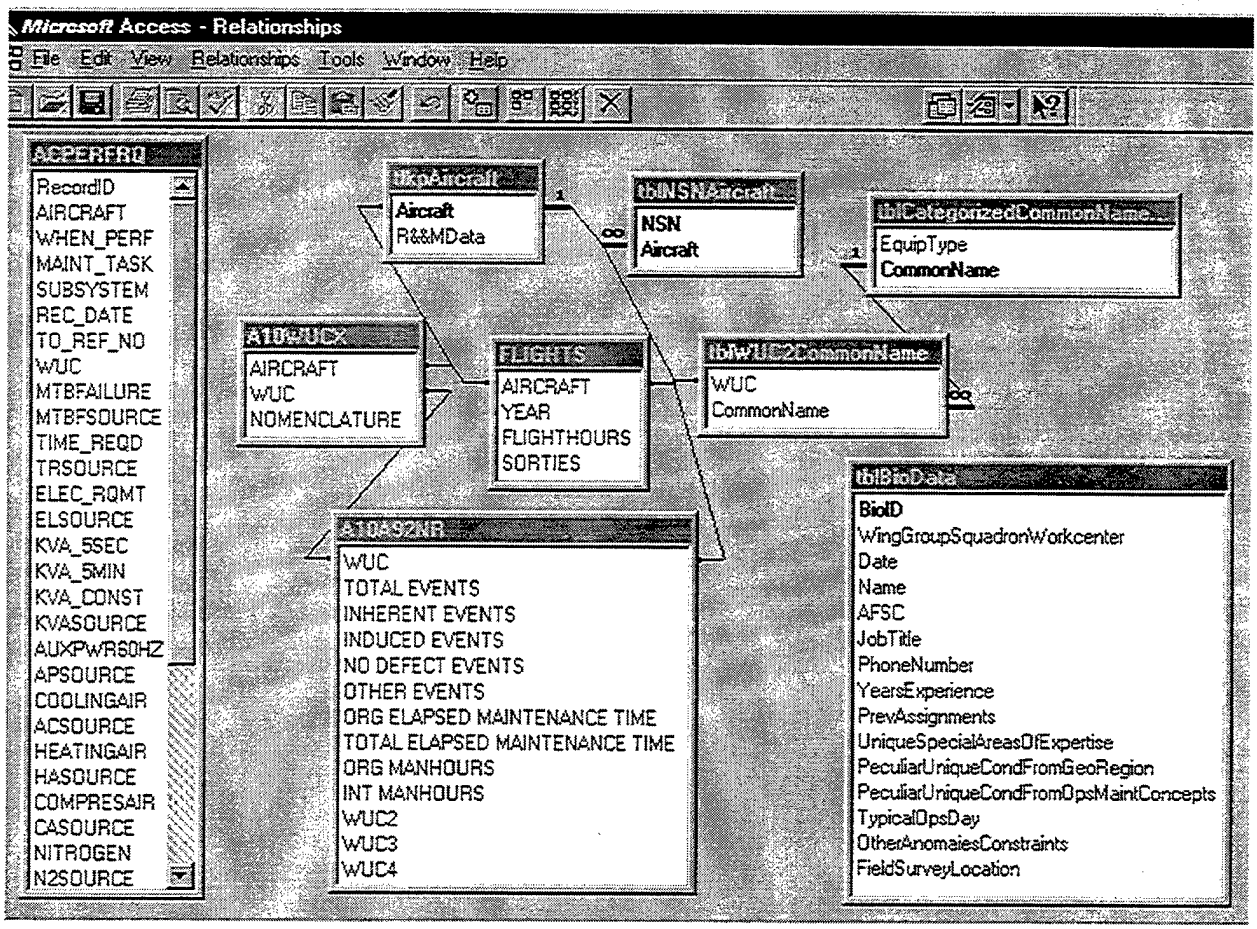


Figure 6-2. Graphic Relationship Diagram Part Two

To aid in the development of the database relationships, similarly functioning SE items were grouped and normalized with a common naming convention (shown in Figure 6-3). This not only provided a means of linking the items to the SE characteristics data, it also greatly enhances the ease with which the user can navigate the database. The list of common names depicted in Figure 6-3 includes only those SE items which were specifically addressed in the course of the SEEIT study. Additional articles of SE that were imported as part of the COLORS database information can also be found in the SEEIT database, along with their physical characteristics, function, cost, etc.

SEEIT Database Equipment Naming Convention

Equipment Type	Common Name
Air Compressor	MC-1A Compressor, MC-2A Compressor, MC-7 Compressor
Air Conditioner	-10 Air Conditioner, Air Conditioner, HDU 13 Heater/Air Conditioner, MA-3 Air Conditioner
Aircraft Deicer/Washer	Engine Water Wash Carts
Auxiliary Lighting	NF-2 Floodlight Set, NF-2D Floodlight Set, TF-1 Floodlight Set
CAMS	CAMS
Cargo Handling	10K Loader, 25K Loader, 40K Loader
Deployment	Deployment
Environmental	Environmental
Facility	Hush House, RUBB Drop Tank Storage System
General SE	SE in General
Ground Power/Start Cart	-60 Generator Set, -85 Generator Set (GPGS), -86 Generator Set, -95 Start Cart, MA-1A Start Cart, MD-4 Generator, MEP-105 Generator Set
Gun/Loading	Gun Jam Kit, Gun Stand, UALS
Heater	H-1 Heater
Hoist/Slings/Cranes	Cobra Crane, Hoist, Slings, Winches
Hydraulic Equipment	-6 Cart, AV834 Hydraulic Test Stand, Hyd Pumping Units, Hydraulic Equipment (General), MJ2 Mule, MK-3 Mule
Jack	10 Ton Jack, 15 Ton Jack, 20 Ton Jack, Jack Manifold, Jacks (General), MLG Tire Dolly for C-130s, Nose Gear Jack, One Piece Axle Jack, Rhino Axle Jack, Tripod Jack, Two-Piece Axle Jack, Universal Jack Tester
Lift Truck/Jammer	Manually Operated Lift Truck, MHU-83 Jammer, MJ-1 Jammer, MJ-4 Jammer, MJ-40 Jammer
Maintenance Stand	B-1 Stand, B-2 Stand, B-4 Stand, B-5 Stand, C-1 Stand, C-5 Stand, Maintenance Stands (General), Tank Build-Up Stand, Universal Stand
Misc In-Shop Equipment	Batteries, Battery Charger, Hose Assembly, HT-400, Large Part Cleaner, Purge Unit, Spin Riveter, Tubing Bender, Universal Fuel Tank Certifier
Servicing	Gaseous Nitrogen Cart, GOX Cart, Liquid Nitrogen Cart, LOX Cart, Oil Cart
Special Purpose Flightline Test Set	Cabin Leakage Tester, H-70 Hydrazine Response Trailer AFCTS (Auto Flight Control Test Set), AGM-65 Test Set, AIS, ALM 191 Radar Rcvr Test Station, APU Tester/A-10, Armament Test Set (169), Borescope Test Set, Cable Fab, Carbon Seal Tester (CST), Chaff/Flare Tester (APM-427), CSBPC Test Set, CSFDR, Data Link Test Set, DDU for TEMS, ECM Program Loader Verifier, ECS Tester, Engine Vibration Analyzer, EUS, F-16 Testers, Fire Control Test Set, Flight Systems Testers, Frequency Converter, Gun Fire Test Set, IFF Transponder, ILS Test Set, JFS/CGB Test Stand, K400 Generator Test Stand, Lantirn Test Set, Memory Load Verifier (668)/MLV/PLV, MTS Test Set, Multimeter/Fluke, Phase Angle Volt Meter, Propeller Synchrophaser Test Set, PS-6 Fuel Quantity Test Set, Signal Processor Test Sets, Stray Volts Tester, Transponder Test Set, TTU-205 Pitot Static Tester
Tools	CTK, Engine Tools/Misc.
Tow Vehicle/Truck	Coleman/PSI, Eagle (85/86Ls) (Bobtail), Tow Tractors, Utility Vehicle
Towbar	CFT Dolly Towbar, Universal Towbar
Trailer/Dolly	3000 Engine Trailer, 4000 Engine Trailer, A Frame for C-130 Engine Change A-10 External Fuel Tank Stand, A-10 Tank Loader, Engine Change Beam/A-10 F-16 Centerline Tank Dolly, Fuel Tank Dolly, MHU-141 Trailer, Trailers (General)

Figure 6-3. Naming Convention: Equipment Type to Common Name

User Interface

The SEEIT User Interface was designed to be as user-friendly as possible. On opening the database, the user is taken directly to the Main Switchboard (Figure 6-4). Then by clicking buttons or making selections from various types of controls, the user can view the information in the database from many different directions. As an added feature, each form has its own Help Window which contains useful information on how that particular form is designed to work.

In addition, a sample of Reliability and Maintainability data was incorporated in order to demonstrate the potential for future growth of the database. Using MS Access, data tables are easily added and linked to the existing tables, allowing for expansion into a wide spectrum of related activities including simulation modeling and aircraft analysis.

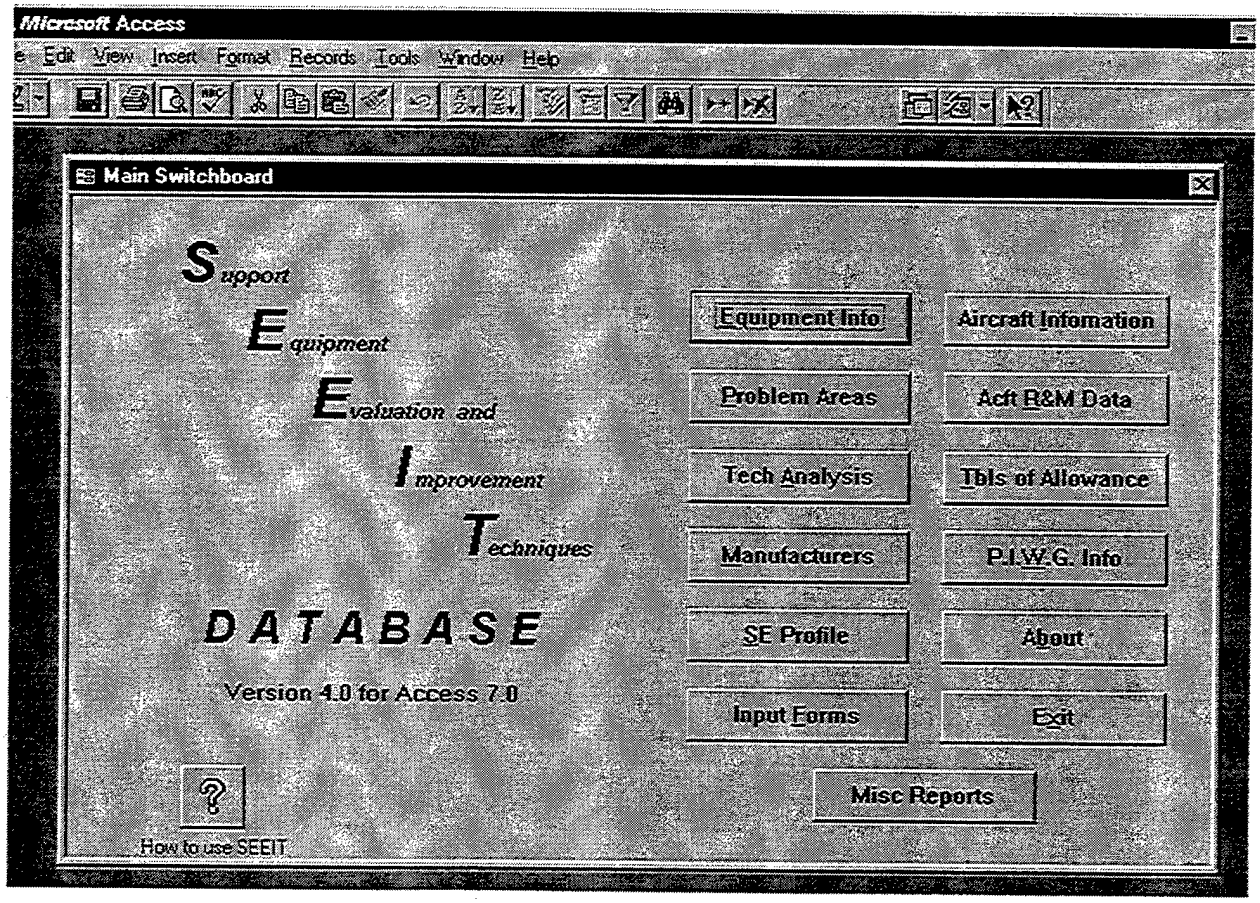


Figure 6-4. SEEIT Main Switchboard

Outputs

The database was developed with report-generating flexibility in mind. Each form has a Report button which allows the user to generate a printed copy of the data that has been selected. Previously generated sets of reports are also available from the Main Switchboard which supplement/summarize the SEEIT findings. Additionally, the SEEIT database allows the user to generate customized reports which include any or all database elements.

6.3 Database Requirements

In order to run the SEEIT database the following requirements should be taken into consideration:

Operating Systems Requirements

Microsoft Windows 95 is required to run Access 7.0, either within the full version Access environment, or the run-time version. Attempting to run the SEEIT Database without Windows 95 will result in a crash of the current operating system.

Software Requirements

Microsoft Access 7.0: If the user does not want to purchase MS Access, a run-time version of the database can be provided. The runtime version allows the user full interface operation and full access to all of the data, forms and reports, but does not allow the user to modify or add any data, forms or reports. With the runtime version, all design views are disabled and the Database Window is hidden.

Hardware Requirements

RAM: 16 to 32 Mb

Hard Disk Space: Approximately 20 Mb

CPU: 486 100 MHz or greater

Monitor: VGA with Min 1 Mb RAM, 256 color capability: This allows the viewing of color pictures of items that have been scanned and linked to the database.

Appendix 1 - Table of Contents

SEEIT PROBLEM AREAS AND DEFICIENCIES

Air Compressor

MC-1A Compressor

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
423	NAFB	6			Compressor oil collects moisture in humid climates.		X	X					
1077	NAFB	(6)	423		Moisture gets in the oil.....traps don't get it all. May be due to the dehydrator being located at the end of the system.		X	X					
1170	NAFB	6			Fuel lines on top of engine area have a tendency to leak due to cracks caused by excessive vibration. Other parts have cracked and fallen off. Engine is good otherwise.		X						
157	PAFB	5			Glow plug coil breaks down and the pieces go down in the engine intake, which break the valves. Requires replacement of the engine head. Happens on all diesel equipment		X		X				X
424	NAFB	5			Ignition switch not visible, can shut off engine without shutting off ignition which runs down the battery.	X			X				
156	PAFB	3			When close to the ocean, the compression process generates lots of water in the system, necessitating many filter change-outs and draining and flushing of the units			X					
158	PAFB	3			The exhaust system wet stacks and causes all sorts of problems			X					
426	MHAFB	3			Won't start, or start and then quit.	X							
155	PAFB	2			Need longer hoses to service C-130 accumulators. Highpac hoses have to be run through an emergency escape hatch. 20 feet more would solve this problem.	X	X						
1075	NAFB	2			Davey unit has too many lines. Looks like spaghetti and causes chafing.		X	X					
1076	NAFB	2			Hose reels do not lock any longer.	X	X						
1243	MHAFB	2			Unit is believed to be under powered. Would reduce vibration problems.			X					
425	MHAFB			NR	High pac's are a reliability/availability problem.	X			X				
427	MHAFB			NR	Have an option to service with either air or nitrogen; recommend getting rid of the high pac's and provide a good nitrogen system.				X				X
428	MHAFB			NR	High pac air source on the KC-135 would be desirable.				X				X
1108	NAFB			NR	There is an approved modification to the tow bar bushing area on the high PAC that should be done on more equipment. Reportedly, the mod is compatible with most rolling stock.		X	X					X

MC-2A Compressor

417	NAFB	7			Have fasteners that vibrate off (supposed to be captive (quarter turns) but vibrate off).		X	X					
1109	NAFB	(7)	417		The housing on the Davey Lo PACs makes for good accessibility but has too many fasteners which could create a FOD hazard. Consider use of a fiberglass housing. The sheet metal that is currently used is too thin and has a tendency to crack.			X	X				X
1308	LAFB	(7)	417		Zeus-type fasteners on doors are a FOD hazard.		X						
949	LAFB	7			New units, plastic fuel tanks are cracking		X						
1310	LAFB	(7)	949		New plastic fuel tank cracks.		X						
144	PAFB	6			Manufacturer's switches faulty (ones with a tall throw) due to corrosion from water intrusion. In years past, the glow plug switch next to the fuel filter would short out due to corrosion and the unit would catch on fire		X				X		
146	PAFB	(6)	144		Unit has a history of setting itself on fire		X				X		
145	PAFB	6			Voltage regulator shorts out and disintegrates. This also burns up all of the attaching wires. Unit nearly catches on fire.		X				X		

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
153	PAFB	6			On newer units, sheet metal control panel doors hinge downward and people often walk into them and get ripped up. Would be better for them to hinge upward like older units	X					X		
947	LAFB	6			New diesel engines, chronic rocker arm wear		X						
1309	LAFB	6			Nine out of ten of the bypass oil cooler electric fan temperature sensor are bad.		X						
142	PAFB	5			Dead batteries are an aggravation		X						
150	PAFB	5			Newer MC-2 units have an internal plastic gear and disk that turns the starter and helps kick the bendix out. This gear frequently strips, which requires replacement of the starter. Internal gears are plastic and won't last		X						
154	PAFB	5			Glow plug coil breaks down and the pieces go down in the engine intake, which break the valves. Requires replacement of the engine head. Happens on all diesel equipment		X		X				X
147	PAFB	4			On normal shutdown procedures, the fuel solenoid keeps running from 30 to 60 seconds, causing vibrations. A plastic fuel seal on the solenoid cracks, allowing air to be sucked into the line. A steel replacement with a rubber insert will solve the problem		X						X
418	NAFB	(4)	147		Fuel solenoid leaks fuel at shutoff and engine continues to run.	X							
148	PAFB	4			Red air hoses for front reel are plagued with dry rot. Hoses from Base Supply have dry rot. The old style cloth-covered hoses last longer, even though they did get chafed and looked bad. Red hoses don't last.		X		X				
141	PAFB	3			Hard to start	X							
143	PAFB	3			Exhaust box breaks all the time due to vibration.		X						
151	PAFB	3			When close to the ocean, the compression process generates lots of water in the system, necessitating many filter change-outs and draining and flushing of the units			X					
152	PAFB	3			Sheet metal access doors on Ingersol Rand units warp to such an extent that it causes difficulty latching the doors	X	X						
1146	NAFB	3			Hoses and harnesses are chafing.			X	X				
1294	LAFB	3			Separator pads clog causing unit to spew oil.	X	X						
420	MHAFB	2			Need to add about five feet of hose to the low pac.	X							
421	LAFB	2			Low pac hoses wear out in 3-4 months.		X						
945	LAFB	2			Post ignition after shutdown during cold weather		X						
1148	NAFB	(2)	945		The fuel shutoff valve on the Davey models work good. The Ingersoll Rand models continue to run. Suspect weak solenoid on shutoff valve.	X					X		
149	PAFB	1			Replacement hoses come in different sizes. Hoses come in different pressure ratings. With too big of a diameter, hose will not fit the reel itself				X				
946	LAFB	1			Oil servicing difficult, have to use long flexible funnel			X					
948	LAFB	1			Oil filter hard to remove when over torqued - have to puncture filter with screw driver and then turn (inaccessible with strap wrench)			X					
1307	LAFB	1			Left side door lays on tire when open.	X							
419	MHAFB			NR	Low pac's are used on tires, but will probably convert to nitrogen.				X				X

MC-7 Compressor

242	PAFB	7			Used with fuel cell carts, but unit shoots a lot of water out of the line, which damages ram air pumps and VMPs. When the water freezes, the external tanks won't pressurize. Needs a water separator or dehydrator	X							X
422	PAFB	(7)	242		MC-7 needs filter to take water out of the air.	X	X	X					
1110	NAFB	7			The housing on the Davey Lo PACs makes for good accessibility but has too many fasteners which could create a FOD hazard. Consider use of a fiberglass housing. The sheet metal that is currently used is too thin and has a tendency to crack.			X	X				X

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
1150	NAFB	7			Fuel tanks on Davey units tend to crack and leak due to vibration.		X						
1171	NAFB	6			Fuel lines on top of engine area have a tendency to leak due to cracks caused by excessive vibration. Other parts have cracked and fallen off. Engine is good otherwise.		X						
1147	NAFB	3			Hoses and harnesses are chafing.			X	X				
1230	MHAFB	3			Unit is very slow to service with oil due to the position of the port (near bottom). Must service one drop at a time.			X					
1293	LAFB	3			Separator pads clog causing unit to spew oil.	X	X						
1322	LAFB	3			Compressor is difficult to adjust.			X					
1149	NAFB	2			The fuel shutoff valve on the Davey models work good. The Ingersoll Rand models continue to run. Suspect weak solenoid on shutoff valve.	X					X		
1151	NAFB	2			Brake drums on the Keco units get out of round. Suspect this is due to the brake getting too hot during towing then catching. Original tolerances were too tight.	X	X	X					
1152	NAFB			NR	Paint washed off new unit (believe it was a Keco model). Could not repaint it at paint barn due to the warranty		X	X					

Air Conditioner

-10 Air Conditioner

300	KAFB	9			They're losing expansion turbines due to water condensation in the oil; summer moisture is a problem here causing corrosion		X	X					
911	LAFB	8			When sloot air line clamp blows off, all plastic lines melt in compartment - maintainers have incorporated a wiggins fitting & install immediately on new units		X	X					
313	NAFB	(8)	911		Blasting lines can melt if air leaks. (plastic lines?)		X	X					
1174	NAFB	(8)	911		The -10D is built with all plastic lines. If one blows, the unit can reach temperatures of 400 to 500 degrees which melts all the lines.		X	X					
1282	LAFB	(8)	911		If clamps vibrate off sloots the plastic lines will melt if not caught right away.		X						
1305	LAFB	(8)	911		Replaced the stock clamps on the sloots with V band type clamps (approx $160 per clamp).		X	X					
246	PAFB	7			Maximum cooling output of 55 degrees on a hot day. Should be able to cool to 40 degrees	X							X
250	PAFB	(7)	246		User problem between the C and D model. The user will pull the combined flow to get more volume. This will heat the air on the C model. User thinks the unit is inop, although it is not. Training problem	X			X				
310	NAFB	(7)	246		Does not provide adequate cooling for summer operations	X			X				
322	MHAFB	(7)	246		Doesn't put out enough air in either hot or cold weather; the -85 is OK.	X			X				
1089	MHAFB	(7)	246		Approximately eight out of ten -10s do not work correctly. The ECS light stays on due to low pressure.	X	X						
1132	MHAFB	(7)	246		Unit only provides enough air 10 percent of the time.	X	X						
247	PAFB	7			Due to high humidity, the coalescent bag freezes up in the C-10D. Needs a screen and a drain in the air stream before the bag to break down the moisture to smaller pieces to prevent clogging of bag			X					X
249	PAFB	(7)	247		One maintainer thought the C unit produced more water than the D model in Saudi Arabia. Excess water would enter in the aircraft electronics. Didn't have drain on unit. Can avoid problems by bringing aircraft to ambient temperature	X							X
1090	MHAFB	(7)	247		There is too much moisture in the -10 air.	X	X						
248	PAFB	7			The C-10D unit doesn't handle very much air pressure, particularly in wintertime when air is heavier. Supposed to handle up to 45, but lower pressures can blow the bleed air sloot off on the inside	X							
309	NAFB	7			Hose not rugged; blows out if bent (same hose on all carts, lose an average of a hose a day).	X	X	X					

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
308	NAFB	(7)	309		Tabs break off connectors from being dropped.	X	X	X					
312	NAFB	(7)	309		Potential safety problem; turning on the pressure to the C-10 could blow something.	X					X		
319	MHAFB	(7)	309		Air conditioners are difficult to hook up because of damage (large aluminum rings get knocked out of round and ratchets are damaged).	X	X	X					
1283	LAFB	(7)	309		Ducts need to be made to handle higher temperatures and some abuse.		X						
320	MHAFB	7			Very unreliable, with pressure as the prime problem (15C's and F111's). The only difference in pressure is when the ICS is on/off.	X	X						
1080	NAFB	7			Valve E-7 (-10D) has poor reliability. The rubber diaphragm wears out and can't be ordered separately even though it is easy to replace. The valve cost is in excess of $800.		X	X	X				
251	PAFB	6			Weight on the towbar is too heavy. Difficult to hook unit up to tow tractor	X					X		
305	LAFB	(6)	251		-10D carts need to be balanced, too heavy in front.	X				X	X		
306	LAFB	(6)	251		-10D model tow bar is too heavy - move axle or make it four (4) wheels.	X				X	X		
323	PAFB	(6)	251		A/M32D-10 towbar is hard to use to put the wheel down.	X					X		
910	LAFB	(6)	251		Tow bar very unstable, needs 4 wheels - Female crew chief was pinned (arm caught) down for approx one hour out in the flight line (2nd shift)	X					X		
1281	LAFB	(6)	251		Balance of unit is no good. Would like to see four wheels and a retractable towbar.	X					X		
1306	LAFB	5			Fittings are always too small for the plastic lines (ordered per the TO) and must be bored out.			X					
252	PAFB	3			If doors are closed during unit start up, it will suck the doors in. This permanently bends the doors	X							
912	LAFB	(3)	252		Doors need to bolted open during operation, if left closed doors will suck in (implode)						X		
1284	LAFB	(3)	252		Had to modify the doors on the D-models to keep them open. If doors close when unit is running it will collapse.	X	X						
314	NAFB	3			Flow meters are inaccurate, may read max output only (adjustment is a diaphragm).	X	X						
1081	NAFB	(3)	314		Flowmeter is inaccurate.	X	X						
311	NAFB	2			Problems adjusting temperature, sometimes turning the knob down unscrews it and it falls off.	X		X					
315	KAFB			NR	Kelly has a local repair contract for the -10; ATS does the overhaul.				X				
316	KAFB			NR	-10D's entered service in October/1988 (600 plus units); have a 12 year plan life which has been moved up to 15 years.				X				X
317	KAFB			NR	Overhaul is on-condition; field level repairable.				X				X
318	KAFB			NR	-10's are replaced when repair cost exceeds the specified expense of initial cost.				X				X
321	MHAFB			NR	Never use the onboard ICS.	X							X
1285	LAFB			NR	Would like to see composite enclosures.			X					X

Air Conditioner

298	KAFB	5			The biggest problem with the new units is lack of training and lack of TO's			X	X				
295	KAFB	3			Corrosion is their biggest problem (everywhere, particularly the corners of the cabinets).		X	X	X				
294	KAFB			NR	Reefer units (vapor cycles) are being replaced.								X
296	KAFB			NR	Reciprocating compressors were a problem; being replaced by rotaries.		X	X	X				
297	KAFB			NR	New units have electronic controls, the newer people like them and the older people don't; hand held electronic diagnostics are an advantage, they plug into MA3D's and C5 air conditioners (both are 20 on units) the A3D's and C4's are going.	X		X					
299	KAFB			NR	They have about 800 air conditioners in the field; new ones use 183 refrigerant			X	X				
301	KAFB			NR	DDEC (Detroit & Diesel Electronic Control) monitor the diesel engine unit (MA3D)								X

ID:	Loc:	SevFac:		Ref:	Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
302	KAFB			NR	The master plan identifies replacement criteria								X
303	KAFB			NR	Freon recovery is an issue because special systems are required; these are used on the B-1, MA3D, C5 etc. vapor cycles			X	X				
304	KAFB			NR	B1 air conditioner takes 120 tons (equivalent of 5 MA3's)								X
307	LAFB			NR	Make door/panels of kevlar/composite material to make them lighter, minimize welding repairs, and no painting required.	X		X	X				

HDU 13 Heater/Air Conditioner

224	PAFB	0			Generally likes the unit, but the heat function is unreliable. Air temperature cools before it reaches the end of the duct.	X	X						

MA-3 Air Conditioner

843	KAFB	5			Units have been seizing due to not pumping down compressor (5 failures). Technical Order problem, did not have TOs in the field due to late printing				X				
842	KAFB	3			Corrosion in cabinets/corners or where ever moisture can settle. Have tried to address problem with different type of paints to no avail. Composites would be the answer in this area		X	X	X				
841	KAFB			NR	Gas engines are being replaced by diesel		X						

Aircraft Deicer/Washer

Engine Water Wash Carts

38	PAFB	3			Mounted compressor often doesn't work, thus requiring a Lowpac to pressurize the unit		X						
41	PAFB	3			Units don't start very well	X							
39	PAFB	2			Gauges often don't work		X						
42	PAFB	2			Unit has too many gauges and knobs that are never used by the operator. Since the unit has pressure regulators on it, the operator only needs to set the water volume. Recommend separating the panels for user verses AGE maintainer	X							X
616	PAFB	(2)	42		Water wash unit has too many gauges.	X							
40	PAFB	1			Although there are separate tanks for both water and soap, they are often found mixed together in the tanks	X							

Auxiliary Lighting

NF-2 Floodlight Set

431	NAFB	4			Voltage regulators: don't last; a lot of manufacturing; wiring unknown (generator WINCO 3KW, 60 Hz, NSN 6115-01-346-5129).		X		X				
430	NAFB	3			Tend to be top heavy; have been known to tip over in the wind.	X			X				
193	PAFB	2			Ground clearance not sufficient on older gas-style units. Constantly getting banged into things	X							
433	PAFB	2			NF-2 units are slow.	X							
1262	LAFB	2			Old style lamps need to be replaced. Have radiation warning.	X					X		
1263	LAFB	2			The brake test often fails for the raise table assy.		X				X		
429	NAFB			NR	Used as a power source for borescope.	X			X				X
432	NAFB			NR	Are in the process of changing out the engines from gasoline to diesel.			X	X				

NF-2D Floodlight Set

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
188	PAFB	7			Vibration causes cracking in the back field section of generators. This separation allows the whole field to spin, breaking off the wires going to the diodes. Generators must be salvaged		X		X				
435	PAFB	(7)	188		Generators come apart and cracks.		X						
879	KAFB	(7)	188		Engine/Generator 40 mils vibration - Problem was a marriage of a commercial diesel engine, DoD generator and isolator/mount system		X						
190	PAFB	7			Nutplates do not remain captive. Have to remove them before they fall off inside. They are not doing their job.		X						
186	PAFB	6			Bad engine design as push rods criss-cross and rub against each other. Resultant metal wear causes rods to snap. Repair also requires new heads and pistons. Local vendors are vital to support NF-2s. ACC has a retrofit engine and generator kit forthcoming		X		X				X
187	PAFB	6			DC voltage regulators constantly short out and fail. Suspect bad supply source. This also causes batteries to fail, and units always require jump starting on the flightline		X		X				
1027	LAFB	(6)	187		Voltage regulator failure rate is about one per month, even with incorporation of shock mount modification & RTV for sealing		X						
1214	NAFB	(6)	187		AC voltage regulators are no good and are no longer being produced. Regulators that are fresh out of the box from supply may last one hour, one day or not work at all.		X		X				
1234	MHAFB	(6)	187		Put rubber shock mounts on voltage regulators and prevented water intrusion...fixed many of the problems.			X					
1373	LAFB	(6)	187		Voltage regulators are replaced once a month even though they are on shock mounts and sealed with RTV.		X						
1159	NAFB	6			Believe Rugerini engine is being overworked (running at 3000 rpm, should run approx. 1800 rpm) causing valve to drop out putting hole in piston. Can't get engines any longer...takes over 3 months.		X		X				
192	PAFB	(6)	1159		Believe engine was overrated for the intended load application. Not running at right speed to work it and loads up. Engine would disintegrate if run at any higher speed		X						X
1031	LAFB	(6)	1159		Ruggerini diesel engine, 3 of the 7 engines received last year have failed		X						
1161	NAFB	6			Rear main oil seal blows on engine. Either replace seal or replace entire engine.		X						
185	PAFB	5			Parts are hard to get even for routine things. The old gas-style NF-2 is sent for flightline use because the parts are easier to get. The newer style NF-2 units would otherwise all be redlined for parts. Mfgr went out of business				X				
436	PAFB	(5)	185		Lack of parts because vendor lost contract.			X	X				
439	PAFB	(5)	185		With loss of vendor parts are hard to find because of no change in TO.			X	X			X	
1232	MHAFB	5			If you use the 110v 60hz outlet, one light goes out.	X	X						
881	KAFB	(5)	1232		Engineering problem explanation was marginal KW power output with full load therefore must shutdown one of the lights when using outlet								X
1030	LAFB	(5)	1232		Utility outlet is one phase therefore when lights are on (full load) & outlet is being used, one or both lights will go out	X	X						
189	PAFB	4			Switches are bad, for both start and lighting. Continuity checks indicate switches break down inside		X						
414	LAFB	4			NF-2D wire diagram and schematic useless.			X					
1025	LAFB	(4)	414		Electrical schematics are worthless	X			X				
1160	NAFB	(4)	414		Schematics for this unit suck bad. Can't tell what relay K1 is supposed to do.	X		X					
1371	LAFB	(4)	414		Schematics and diagrams for this unit are useless.			X					
415	LAFB	4			NF-2D has Ruggerini diesel that produces high vibration that damages unit.		X						
437	PAFB	(4)	415		Vibrations cause cracks and exhaust problems.		X						
1029	LAFB	4			KX relay terminals break off due to corrosion		X						
182	PAFB	3			Need more 110v outlets for troublelights, HT 900 heatguns, soldering guns, etc.	X							X
191	PAFB	3			Muffler wet stacks and collects condensation. May be the source of the smoking	X							

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
1024	LAFB	3			Hard starting - possible prime problem		X						
1321	LAFB	(3)	1024		Unit is difficult to start. Needs prime or something.	X							
1028	LAFB	3			K2 relay can't access mounting screws			X					
1261	LAFB	(3)	1028		Can't access bottom mounting screw on lockout relay K-2. Relay corrodes quickly and breaks off.		X	X					
1286	LAFB	3			Many problems develop following washing. Seals go bad quickly.		X	X					
183	PAFB	2			Would like bigger gas tanks for longer operation between refueling	X							
184	PAFB	2			Exhaust is routed to the ground and carbon monoxide bounces up around unit and stifles user. The problem is only mitigated by a breezy day	X					X		
434	PAFB	2			NF-2D exhaust needs to be turned up above head level.	X					X		
438	PAFB	2			Unit takes long time to shut down.	X							
1266	LAFB	2			Clamp on exhaust always breaks. Should reroute to bottom.		X						
1026	LAFB	1			Oil tank servicing is very difficult due to tight location - top of engine with approx 4" space to get in with oil can			X					
1372	LAFB	(1)	1026		Oil fill is in a bad location. Can also spill out if filling too fast.			X					
1032	LAFB	1			Brake cable malfunction - 1 failure/year		X						
1034	LAFB	1			Lights flicker		X						
416	LAFB	0			NF-2D must open rear door during warm temperature operation or engine will over heat. There is an instruction panel to this effect.	X							X
1033	LAFB	(0)	416		During summer must open doors per placard or generator will over heat	X	X						
181	PAFB			NR	Lighting system on the newer ones are impressive. Halogen lighting is superior. Very good maneuverability	X							
876	KAFB			NR	DoD's Acquisition reform initiatives brings new challenges to new floodlight procurement								X
877	KAFB			NR	New procurement of commercial off-the-shelf equipment, Difficult to merge commercial units into AF user wants:								X
878	KAFB			NR	No longer acceptable to procure products using MIL-STDs/SPECs without renewed justification								X
880	KAFB			NR	Sanity checked field problem of; when lights are on and plug into 110 outlet, lights will go out - SA-ALC states problem was not reported to engineering and presently there will be no modifications due to new floodlight procurement -		X						

TF-1 Floodlight Set

194	PAFB	3			Have a tendency to blow over in the wind, but are not used much on the flightline	X							

CAMS

CAMS

1242	MHAFB	5			Would like to see automated 244 form instead of CAMS. Would have history forever.				X			X	
774	KAFB	(5)	1242		Field people want the 244 Form computerized. Beale has developed a database for AGE.				X			X	X
1369	LAFB	(5)	1242		CAMS is not used on jobs that take less than 1-2 hours unless parts are ordered. (One CAT claims to use CAMS all the time.)				X			X	
1103	NAFB	4			Would like to FEDLOG capability combined with CAMS.	X							X
697	NAFB			NR	Maintenance data is entered into Cams and Maintenance log books (244 forms provide historical data).				X			X	X
773	KAFB			NR	Kelly is trying to get the field to use CAMS but the field doesn't like CAMS and REMIS. A new system is on the horizon that is more user friendly (IMIS).				X			X	X

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com

Cargo Handling

10K Loader

255	PAFB	2			Not very maneuverable. Can't get into the corners like the RT, which is unibody.	X				X			

25K Loader

256	PAFB			NR	Much less problems in all areas	X	X			X			
790	PAFB			NR	New 25K loader is the best.	X				X			

40K Loader

254	PAFB	9			Most common problem is that it frequently fails to lift to platform level. Or if it does extend, it will not lower. Still has many hydraulic leaks		X			X			
789	PAFB	(9)	254		Hydraulic controls on 40K loader needs to be improved.		X			X			

Deployment

Deployment

1420	SEEIT	5			Deployability (Hard to Load): Numerous instances of SE not designed for efficient cargo loading and handling, too heavy and bulky, not stackable, fixed tongues, oversized dimensions, multiple single function units.					X			
13	PAFB	4			Needs a fork lift or crane just to get the B-1 stand on the loader for deployment. Need something that is lighter weight and breaks down and snaps together					X			
35	PAFB	4			Stands get damaged when trying to stack them. Needs to be designed for easy stacking with a simple strap down method. (B-4 Stand)					X			
37	PAFB	4			Stands get damaged when trying to stack them. Needs to be designed for easy stacking with a simple strap down method. (C-1 Stand)					X			
586	LAFB	4			Stands (cube) out before they (weight out).					X			
801	MHAFB	4			Jammers are most difficult to load because of ramp clearance (C141) hydraulic hose assembly that goes to the table is the part most frequently damaged.					X			
901	LAFB	4			Jammers - shoring needed to prevent damage to table's hydraulic lines					X			
206	PAFB	3			For equipment accountability, as well as airlift traceability purposes, bar coding of SE would save time and improve accuracy. Bar coding on ID cards is already being used to some extent for personnel processing.					X			X
738	PAFB	(3)	206		Bar codes need to be on almost everything; makes loading easy and faster.					X			X
740	PAFB	(3)	206		Better tracking of cargo to insure faster offload at final destination.					X			X
207	PAFB	3			In terms of airlift processing, pallets are preferred over rolling stock because they don't need winching on the aircraft or special driving certification. SE tongues also take up extra space, sometimes half a pallet					X			X
258	PAFB	3			AGE Fuel Tanks - Some are difficult to drain in preparation for airlift					X			X
893	LAFB	(3)	258		Must defuel rolling stock tanks 3/4 (C-130, C-5) to 1/2 (C-141), some SE do not have drains therefore must siphon. Very time consuming.					X			
909	LAFB	(3)	258		Biggest complaint is defueling AGE & some units don't have drain valves, therefore must siphon					X			
739	PAFB	3			Rolling stock has longer loading time than pallets.					X			X
795	MHAFB	3			Most of the problems in mobility/deployment are: Munitions trailer, Hydraulic servicing carts (large and small) are leakers, Engine trailers					X			
796	MHAFB	3			Empty trailers are empty space and designing adapters to carry other equipment would help; some trailers stack - three stack on MHU110's, two stack on MHU141's; sometime ship with ECM pods on board.					X			

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
894	LAFB	(3)	796		Trailers - MHU 141 & engine (Wasted space)					X			
1378	LAFB	(3)	796		Most inefficient piece in terms of wasted space, etc. (MHU-141)					X			
816	MHAFB	3			15-E Avionics equipment for deployment: 30 day package Takes only a few hours; is modularized Older test sets are large and heavy Prime improvement would be miniaturization Recommend combining various radio test sets into one.				X	X			
818	MHAFB	3			F-15 requires three pallets per trailer, eight trailers (18-24 pallets) and between 6-8 shelters.				X	X			
819	MHAFB	(3)	818		Need forty bays/month to support forty-four aircraft's (two squadrons), thus requires two TEWS. Takes 3 pallets/TEWS plus the data link (one pallet) Constant updates (through E-Mail from other bases)					X			
826	MHAFB	3			Paperwork becomes a burden					X		X	
1355	LAFB	(3)	826		Admin is largest problem come mobility time.							X	
895	LAFB	3			Stands - B-1 (doesn't collapse very low), B-4, & C-1 are contributors to cubing out before weighing out					X			
741	PAFB	(3)	895		Need new stands that can be taken apart for mobility.					X			X
1312	LAFB	(3)	895		Maintenance stands are waste of space. Make collapsible or stackable. B-1 stand is the worst.					X			
1385	LAFB	(3)	895		Maintenance stands are waste of space. Make collapsible or stackable. B-1 stand is the worst.					X			
1386	PAFB	(3)	895		Need new stands that can be taken apart for mobility.					X			X
896	LAFB	3			NF-2 voluminous voids					X			
899	LAFB	3			Weighing & CG check - rolling stock 100%, pallets 10%								X
730	LAFB	(3)	899		Rolling stock is a C/G problem.					X			X
807	MHAFB	(3)	899		Problem with factory marked weights; each unit different so must be checked before each loading.				X	X			
808	MHAFB	(3)	899		Must weigh 100% of rolling stock, 10% of pallets.					X			
1303	LAFB	(3)	899		Weighing for center-of-balance is not that big of deal even though equipment markings are not that good.					X			
1313	LAFB	(3)	899		Feel strain gauges to do COB is a good idea if calibration is kept current.					X			
900	LAFB	3			Mules - leak constantly & heavy/bulky		X			X			
121	PAFB	(3)	900		Mules become frustrated cargo during deployment because the Quick Disconnects start leaking after they have already been prepped/sanitized for shipment.		X			X			
1314	LAFB	(3)	900		Mules are most difficult to load. If anything even looks like it's leaking it doesn't go.					X			
1387	PAFB	(3)	900		Mules become frustrated cargo during deployment because the Quick Disconnects start leaking after they have already been prepped/sanitized for shipment.		X			X			
1389	LAFB	(3)	900		Mules are most difficult to load. If anything even looks like it's leaking it doesn't go.					X			
902	LAFB	3			Fuel bladder 500 gal - need pallet for special handling, very cumbersome					X			
903	LAFB	3			Correct identification of hazardous material is biggest problem.					X			
905	LAFB	3			CRAF - Electro-mechanical equipment not working, e.g., 747's powered rollers		X						
1140	MHAFB	3			Difficult to pack fuel system equipment on a regular pallet. Would be interested in using MRSP bins (cadillac bins) to mobilize. Would probably take two.					X			
1208	NAFB	3			Personnel stated they would prefer the NAVAIR type shelters (avionics).	X				X			X
821	MHAFB	1			Support equipment cases provided with equipment and accountability problem e.g. one other 75 loose pieces must be individually checked; would like boxes designed to house each piece individually so that it can be checked by looking for empty slots.				X	X			
815	MHAFB	0			Footprint is a concern (shoring on board aircraft and unloading).					X			
50	PAFB			NR	Ideal for deployment, as all of the equipment is palletized and the benches work directly off of one -86 unit, while a single MEP 105 services 5 tents for 115v/60 cycle				X	X			X
257	PAFB			NR	KC-10 Requires different load plan than C-141B. Cargo door is smaller and requires that pallets be rebuilt to reduce the pallet height to 80 inches					X			

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655	NAFB			NR	CALM - Programs don't talk to each other. Won't function on a LAN				X	X			X
656	NAFB			NR	Doesn't handle CRAF, CRAF must approve load plan				X	X			X
657	NAFB			NR	Gunther Air Force Base comments: Not responsive to the field, don't know the issues, never see a field rep, field equipment and then ask what the problems are; suggest using private contractors instead.				X	X			X
791	MHAFB			NR	Load limits: Usually cube-out for deployment and weight-out for mobility.					X			
792	MHAFB			NR	B-1 has outsized equipment.					X			
793	MHAFB			NR	Problems with composite deployments: One independent unit (F-16), rest dependent causing support problem; F-16 equipment doesn't support F-15; when deployed uses a centralized age pool; could be resolved by making one of the F-15 squadrons independent.					X			
794	MHAFB			NR	The unit is responsible for deployment prep; if not properly prepped, mobility will reject.					X			
797	MHAFB			NR	All A/L coded equipment is required, but not necessarily shipped for mobility Exercise if available on base (e.g. B1 maintenance stand).					X			
798	MHAFB			NR	CALM doesn't handle CRAF; CRAF must approve their own load plan.				X	X		X	X
799	MHAFB			NR	C141: 42,000 lbs. normal max., cube-out at 28,000-35,000 lbs.					X			X
800	MHAFB			NR	Pallets used on CRAF, are loaded on C141 because easier to load.					X			
802	MHAFB			NR	C141; all equipment either rolled or driven on.					X			
803	MHAFB			NR	If object is bigger than one pallet, will tie two together.					X			
804	MHAFB			NR	Seven man load teams utilized.					X			
805	MHAFB			NR	Average time to load: C141 is 1 hour C-5 is 1 hour 25 minutes MOP gear adds 35 minutes to each load; biggest problem is driving the equipment					X			
806	MHAFB			NR	Self-propelled equipment is all winched on.					X			
809	MHAFB			NR	COMPES (Contingency Operations Mobility Planning and Execution System)					X			
810	MHAFB			NR	Many bases don't have fully functional ready teams due to elimination of regulations.					X			
811	MHAFB			NR	Mountain Home gives themselves 9 out of 10 for efficient use of space.					X			
812	MHAFB			NR	C-17 loads entirely differently (long) from C-5 and 141 (loads sideways) if C-17 is loaded from the side it cuts the pallet load in half.					X			
813	MHAFB			NR	Deploy by unit only, no composite wing deployments.					X			
814	MHAFB			NR	About 30% of listed equipment is available and doesn't have to be shipped.					X			
817	MHAFB			NR	F-16 requires three pallets, can be consolidated. (AIS)				X	X			
820	MHAFB			NR	Pneudraulics Deployment: See package on 30 day; take small test stand on 30 day follow-on (goes on one pallet).					X			
822	MHAFB			NR	Not equipped to paint on deployment.					X			X
823	MHAFB			NR	Can't support multiple deployments (problem with composite wing).					X			X
824	MHAFB			NR	Composite wing in theory all goes at once.					X			X
825	MHAFB			NR	Cannot support 2 TDY's going at once because table of allowances does not provide for it					X			X
827	MHAFB			NR	Even if it is for one base, still can't support home.					X			X
828	MHAFB			NR	Hazardous materials: Part of shipping requirements (e.g. hydrazine in 6.8 gallon containers), AGE with fuel systems, etc. Pallets must have containment to handle a full spill. Pallet design must allow for immediate access to the hazardous material.					X	X		
829	MHAFB			NR	Do about one deployment per quarter.					X			X

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891	LAFB			NR	Hot weather (120¡ F flight line) - fatigue & dehydration, should cycle crews but they don't.						X		
892	LAFB			NR	Monsoon Season - July, August & Sept - 1 or 2 times per month, must shutdown/move all units to cover & wait till storm passes (1 to 2 hours)	X							
897	LAFB			NR	LOGFOR/MANFORs are made up by contingency operation mobility planning & execution system (COMPES)							X	
898	LAFB			NR	Using CALM model 5.2 out of Gunther AFB							X	
904	LAFB			NR	Typical load crew size 4 to 5					X			
906	LAFB			NR	CRAF - Example of carriers; Evergreen, FedX & Tower Air - Carrier furnishes load plan/master								X
907	LAFB			NR	12 PAA F-16 aircraft - (7) C-141s					X			
908	LAFB			NR	CG = rear axle wt x width between axle / gross wt					X			
1138	MHAFB			NR	Shortfalls for mobility due to TA authorization (authorized one). Can't support but one deployment.					X			
1304	LAFB			NR	The C-5 has the worst ramp angle, and is the hardest to load. The C-141 is good but the C-130 is the easiest (least angle).					X			X
1311	LAFB			NR	Engine trailers with engines on them are the most difficult to load, etc. Must be palletized on a train (which is fairly efficient)..					X			

Environmental

Environmental

751	NAFB	5			T.O.'s - not in-line with EPA (EPA could shut them down). don't identify alternatives; out of date (some still calling out freon); industry resisting change				X			X	X
762	LAFB	(5)	751		For cleaning, TO's call for Trichlorethlyne (Trich). Soon they won't be able to get Trich because of EPA regulations.				X				X
1084	MHAFB	(5)	751		Some tech orders still call for the use of MEK and spray paint. Can no longer get either. Cooling fluids are also going away.				X			X	X
1086	MHAFB	(5)	751		Many Tech orders are out of date. Particularly where EPA requirements must be met.							X	
1205	NAFB	5			Aircraft battery usage is inordinately high when the weather is hot.		X	X	X				X
1421	SEEIT	5			Environmental (Engine Induced): Numerous instances of SE not meeting current environmental regulations, and low likelihood that fuel or engine modifications being developed will meet future regulatory measures.				X			X	
1422	SEEIT	5			Environmental (HazMat Induced): Excessive need for cleaning solvents, excessive callout of special of greases, oils and paint, use and disposal of protective clothing, continual generation of used oil and coolant for disposal.				X		X	X	
1192	NAFB	4			When temperature is below freezing most units are hard to start (even the heaters). Most -60s will start however. Many of the hard-to-start problems are caused by batteries.		X		X				X
746	NAFB	3			Icing: C5's and C141's ice up fairly fast; use heaters and special brooms to break up the ice to handle ramp icing; no glycol or other fluids are allowed; bleed air could be used to clear the wings.				X				X
748	NAFB	3			Hazardous Materials: Want a reduction in the variety; special requirement proliferated for greases, oils or paints, etc.						X		X

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
714	NAFB	(3)	748		Hazardous Waste: a big problem with the EPA; safety here is required to apply one drop of lubricant to a hinge or handle 50 gallons of crank case oil (Material Safety Data Sheets, MSDS establishes requirements).				X		X		X
715	NAFB	(3)	748		MSDS: required on each piece of equipment separately for some materials, but differs from equipment to equipment. e.g. one lubricant manufacturer requires only rubber gloves, another requires apron, eye protectors, face mask and gloves.				X		X		X
750	NAFB	(3)	748		Would like a minimum level of use criteria for each item that puts it below control requirements (e.g. noted differentiation between three drops of oil on a hinge and 35 gallon drums of materials).						X	X	X
752	NAFB	(3)	748		Broad spectrum of materials included in hazardous waste, includes sanders, solvent, paint, plastic media, rags, masking tape, etc.				X		X		X
753	NAFB	(3)	748		MSDS - every manufacturer has their own and they have to carry them all; there's also no consistency from manufacturer to manufacturer on the same hazardous materials.				X			X	X
755	NAFB	(3)	748		Neutralize hydrazine in salt water, depending on the state, may still require hazardous waste disposal.				X		X	X	X
757	NAFB	(3)	748		Bases generate about four 55 gallon drums per month of various hazardous waste.				X		X		X
766	LAFB	(3)	748		Inconsistency in disposal of hazardous material. Also, changing requirements continually.				X		X		X
1085	MHAFB	(3)	748		Use of isopropyl alcohol is also closely monitored. Need some minimal level established that will permit usage in small quantities that do not need to be reported.				X			X	
1239	MHAFB	(3)	748		Many EPA paint issues. Consider use of composites (would also prevent coastal base corrosion problems).				X				X
758	NAFB	3			JP8 is a hazard - rags must be disposed.				X		X		X
759	NAFB	3			Have not found any lint-free suitable rags.				X				X
760	NAFB	3			Cost: Protective whites have to be disposed of through hazardous waste because of minor stains they believe could be taken care of in a washing machine.				X				X
764	LAFB	3			Protective fuel clothing causes maintainer to sweat profusely to the point of being a safety problem (i.e. glasses have to be removed to clean sweat).				X		X		X
1068	LAFB	(3)	764		Hydrazine response team - must wear Rocket fuel handling suit, very heavy (1/8" thick) & hot (black) with OAT 110¡ F - need lighter suit	X					X		
1069	LAFB	(3)	764		Safety glasses, can't see with heavy perspiration	X					X		
765	LAFB	3			Not much equipment is explosion proof - have to use all hoses to maintain safe distance for fuel work.						X		X
1070	LAFB	3			Booties, when jet is wet very slippery	X					X		
747	NAFB	2			Noise: Hobarts and High pac's are noisy.	X					X		X
756	NAFB	2			Wind: Can't stack tanks more than one high.				X				X
743	NAFB	1			No heat problem with equipment except for moving it around when it gets hot to the touch.	X							X
745	NAFB	(1)	743		Recommend having cool spots on the equipment to push it around.	X							X
1188	NAFB	(1)	743		During the summer months, SE becomes too hot to touch.	X					X		X
742	NAFB			NR	No sand or dust issues with support equipment in general.	X							X
744	NAFB			NR	Heat is considered a personnel issue, not an equipment issue.	X					X		X
749	NAFB			NR	Using paint pens and then a spray paint.				X				X
754	NAFB			NR	In Germany greases and lubricant are hazardous and not allowed, there are no suitable substitutes (how do the Germans do it?).				X			X	X
763	LAFB			NR	Discussed protective clothing, refrigerated suits/vests.								X
767	LAFB			NR	Environmental precaution: Wear gloves and drink a lot of water.						X		X
1066	LAFB			NR	Avionics - High winds must shutdown AIS & LANTIRN shops								X
1067	LAFB			NR	Avionics - Above 80¡ F must shutdown AIS test station								X

ID:	Loc:	SevFac:		Ref:	Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
1071	LAFB			NR	110¡ F days, cycle work load 1 hr on & 1/2 hr off - need gloves, water & sun block								X

Facility

Hush House

614	MHAFB			NR	Two different doors, one with a motor the other a manual roll-up. The left motor (as you look at the door) goes out.		X						
761	NAFB			NR	Hush houses are a problem with sand, dust and snow because of location of the doors which are downstream of the inlet; recommend putting the doors on the outside of the inlet instead.	X							X
960	LAFB			NR	Need a more secure place for parts & panels when running at Max power - pieces blow all over the place				X				
1189	NAFB			NR	Too much dust and sand gets blown into hush house. Takes over two hours to clean out (must sweep then rinse).	X		X					
1190	NAFB			NR	Roll-up door should be on the outside of intake and exhaust baffle area (T-9 and T-10 type).	X							X
1191	NAFB			NR	Hush house doors ice up in some locations use -60s to thaw.	X					X		X

RUBB Drop Tank Storage System

245	PAFB	3			Carousel system vertically hangs tanks from a conveyer system, but requires a special low-slung tank dolly to deliver tanks to or receive tanks from the system. These special dollies cannot be used to deliver tanks to the aircraft	X			X				X

General SE

SE in General

663	NAFB	9			De-contamination of avionics workstation could be a major problem because of the cooling fan.				X				X
213	PAFB	7			Eliminate all Zeus fasteners on every piece of support equipment. They are a FOD hazard. Particularly on jammers		X						X
690	NAFB	(7)	213		FOD is a general problem.				X				X
733	LAFB	7			Connector dust caps (plastic) are cause of FOD on flight line.				X		X		X
1062	LAFB	(7)	733		Cannon plug protective covers, don't fit & fall off	X					X		
1418	SEEIT	7			Reliability (Loose and Missing Fasteners): Numerous instances of nutplates breaking or falling off, too many safety-wired components, troops constantly cut hands/arms on safety wire, Zeus fasteners are a FOD hazard - particularly on jammers, fasteners vibrate off, maintenance stands have loose/missing bolts on steps that fall off.		X				X		
1405	SEEIT	6			Supportability (Engine Induced): Numerous instances of hard starting, cold weather starting, post-ignition on shutdown, wet stacking, vapor lock, glow plug breakdown, low cranking power, battery failures on hot days.				X				
1408	SEEIT	6			Supportability (Procurement Induced): Numerous instances of too many SE models providing duplicate support functions, lack of commonality among parts, difficult procurement of parts , ill-fitting parts, TO errors for parts.				X				
1410	SEEIT	6			Safety (Engine Induced): Numerous instances of SE shooting fire from exhaust area, ignition fires, SE sets itself afire, leaking exhaust, excessively high noise levels from turbine engines, back injuries from pushing or lifting.						X		
210	PAFB	5			On all diesel equipment, the glow plug coil breaks down and the pieces go down in the engine intake, which break the valves. Requires replacement of the engine head.		X						X
212	PAFB	5			Circuit cards get wet. At one time, it was permitted to spread a liquid silicone material on certain cards to seal all of the components on the card		X						X
489	NAFB	5			When start switch is left on and equipment turned off it runs down the battery; can't jump the battery.			X	X				
673	NAFB	5			Would like some standardization on electrical equipment interface; on base they have their own generator, on deployment they have to splice (needs standardized plug).				X	X			X

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675	NAFB	5			Local manufacturer; can make equipment locally under certain conditions (authorized by T/0's Local manufacturer; would like local manufacturers to have drawings included to facilitate subsequent purchases; no drawings creates a problem.				X				X
1139	MHAFB	(5)	675		Locally manufactured items should have drawings included in T.O.s (I.e. filler cap gauges).				X				
705	NAFB	5			Corrective Action system: Big problem getting corrective action through the system.							X	X
706	NAFB	5			Tech order and Accuracy's experienced; problems difficult to fix with item managers because item managers are not knowledgeable. e.g. error T/O-37C2-8-25-4 (Swivel assy comes up Rotary switch in Fed log).							X	X
707	NAFB	5			Item Managers: Different item manager for a nut and bolt that are matched on the same piece of equipment.							X	X
710	NAFB	5			Tech orders are lagging in the system.				X			X	X
719	KAFB	5			Problems experienced with user not knowing how to take care of a new piece of equipment when it is initially deployed.				X				X
844	KAFB	5			Engineer and Equipment Specialist do not keep track of in-coming problem calls therefore no substantiation on what problems to prioritize for corrective action								X
853	KAFB	(5)	844		As stated previously engineers/equipment specialist do not have a efficient way to document field problem phone calls (rely on their recall)								X
1172	NAFB	5			Almost every time a new piece of SE comes in there are no spares in the supply system.				X			X	
1403	SEEIT	5			Reliability (Internal Functionality): Numerous instances of SE units never functioning correctly, frequency or voltage fluctuations, water in the system/oil, power drop-off, or surging, erratic operation, overtemp on hot days.	X	X		X				
1409	SEEIT	5			Deployability (Hard to Load): Numerous instances of SE not designed for efficient cargo loading and handling, too heavy and bulky, not stackable, fixed tongues, oversized dimensions, multiple single function units.					X			
1411	SEEIT	5			Environmental (Engine Induced): Numerous instances of SE not meeting current environmental regulations, and low likelihood that fuel or engine modifications being developed will meet future regulatory measures.				X			X	
1412	SEEIT	5			Environmental (HazMat Induced): Excessive need for cleaning solvents, excessive callout of special of greases, oils and paint, use and disposal of protective clothing, continual generation of used oil and coolant for disposal.				X		X	X	
1413	SEEIT	5			Deployability (Asset Visibility): In preparation for the Gulf War, the US Army sent about 40,000 containers loaded with materiel to Saudi Arabia. About half of them eventually returned to the US, unopened. In many cases, the reason that shipping containers' contents never saw the light of day was because soldiers were overwhelmed by the basic task of trying to determine what was in the various containers. An integrated, near-time focused logistics system is needed with a planning and decision support capability. The system should track all classes of supply, prepositioned war reserve assets, and personnel.					X			
1416	SEEIT	5			Administrative (Excessive Emissions): Diesel engines in SE not meeting environmental emission standards, too many SE units smoke from wet stacking, post ignition is common occurrence, gas units being replaced by diesel, engine loads up, diesels have problems on JP-8 and smoke on start-up, turbine exhaust emissions way too rich.							X	
1417	SEEIT	5			Supportability (Excessive Procurement Costs): General concern of not being able to afford adequate quantities of some systems such as LiteAlls, LowPacs and -60 generators which are in high use, cannot support but one deployment at a time, feel local bases can do a better buy than the formal Air Force procurement system, T/A not enough equipment to work with, use as much COTS as possible to improve parts availability, particularly short of spare parts for SE, C-130 units need more Hobarts as too much maintenance delay waiting for this unit, seems to be a shortage of -86 units in A-10 squadrons, A-10 doesn't need DC packs on the -86 units, too many different types of mules in inventory (about 25), include R&M in procurement specification, repair kit costs $256 for $29 worth of parts, 6-month wait for new parts, need 10-year guarantee on availability of parts.				X				
205	PAFB	4			Deployed SE left in place (i.e., Kuwait) need separate TAs. Particularly short of spare parts for SE				X	X			X
208	PAFB	4			AGE maintenance personnel want better access to every unit they work on			X					X
209	PAFB	4			Should be allowed to make simple change-outs and suitable subs of general hardware (hinges and latches) so long as it meets or exceeds the original standard. Tech orders too restrictive on this				X			X	X

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214	PAFB	4			AGE maintainer thinks more units should be run on diesel, as lubricating qualities are better, it is less flammable and they take a better load than JP-8. Also is better in hot climate bases. However, JP-8 is widely available from many overseas bases	X							X
659	NAFB	(4)	214		Diesels have problems on JP-8 (e.g. smoke on start up).	X							X
665	NAFB	4			Lack of spare parts for the equipment is a problem.				X			X	X
695	NAFB	(4)	665		Availability of repair parts: Can be a significant problem, some parts are out of production.				X				X
698	NAFB	(4)	665		Repair parts a problem; Some replacement parts like gauges don't fit; parts go through the USAF stock system before crew testing; can't get replacement parts for Christie battery; can't get timers for our RF80H; item managers not up on their system.			X	X				X
722	KAFB	(4)	665		Common logistics problem is unavailability of spare parts.				X				X
683	NAFB	4			Too many GSE engines to support.			X	X				X
708	NAFB	4			Excessive cost driven by tech orders calling out replacement at the sub assembly level rather than part level e.g.'s only needed parts and bearing to repair a wheel; had to take a complete wheel assembly; a rubber diaphragm wears and needs replacement.				X				X
1401	SEEIT	4			Usability (Hard to Use): Numerous instances of units being overly complex, difficult to use, hard to position or hookup or tow, turns wide, hard-to-read gauges, low user proficiency, too many knobs/dials, touchy adjustment.	X							
1402	SEEIT	4			Accessibility (Hard to Service): Numerous instances of lubrication ports hard to service, hard to reach oil filters, easily cracked filter housings, difficult to access batteries, major teardown for changeout of peanut bulbs/meters.			X					
1404	SEEIT	4			Maintainability (Vibration Induced): Numerous instances of broken fuel lines, under-powered vibration, cracked sheetmetal, vibration-chafed hoses and cables, fasteners vibrating off, shutdown vibrations, engine load up.			X					
1407	SEEIT	4			Supportability (Materiel Mgt Induced): Numerous instances of deteriorated supply parts, obsolete parts, back-ordered parts, defective parts from supply, inferior/cheap substitutes, short-lived parts, wrong parts, costly parts.				X				
1414	SEEIT	4			Maintainability (Lack of Computer-Assisted Troubleshooting/Repair Procedures): Need digital displays with step-by-step instructions to reduce technician error, untimely TO changes when paper-based and are a burden to maintain, TO accuracy lagging in system, often outdated, interactive video disk training should be mandatory.			X	X				
1415	SEEIT	4			Supportability (Lack of Training): Numerous instances of operator error of SE due to low frequency of use, biggest problem with SE is operator training, users want instructions simplified, cart is difficult to operate (too many knobs), user instructions confusing, most SE problems are operator induced, TO instructions too complex, 90% of problems due to using wrong knobs, test/repair knobs being turned by users, setup instructions confusing.	X			X				
1419	SEEIT	4			Supportability (Composite Repair): Advanced composites mean higher repair costs, more complex repair procedures, and complicated logistics requirements. Present day repair of composites are not standardized and need shorter cure times, less energy consumption with simpler and more economical tools. Specific repair difficulties faced by aircraft maintainers concerning advanced materials must first be defined before application hardware and training can be developed.			X	X				
661	NAFB	3			NBC: Suggest covers that stay with the equipment that can be used to cover it in the event of an alert.				X				X
662	NAFB	3			ECP's: Slow to get through the system. Moving towards CD ROM (will reduce paperwork problems). Job fair can speed up the process. Should be quarterly and separately funded.							X	X
664	NAFB	(3)	662		Working group solutions problematic because they can only afford to send one person who therefore becomes responsible for all problems (must be very knowledgeable).							X	X
674	NAFB	3			Would like onboard troubleshooting instructions on SE.			X	X				X
1202	NAFB	(3)	674		Training sometimes is not kept current. This is largely a result of the low frequency of use.	X		X			X		X
1203	NAFB	(3)	674		Consider built-in/automated displays of operator manuals, maintenance information, etc.	X		X	X	X			X
689	NAFB	3			Hand tools: Use Snap-On tools now which significantly improves logistics because Snap-On provides on base service & are guaranteed for life.				X				X
691	NAFB	3			Printed instructions on much of the equipment are worn and unreadable.	X		X					X

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692	NAFB	3			Displays: Digital displays with step by step instructions would help, particularly for complex hardware not regularly used (e.g. operation of the nitrogen carts).	X							X
713	NAFB	3			Spot painting a major problem: requires full gear to scrape and sand old paint and repaint; no special paints are required e.g. poly paint for NBC; use of composite panels with imbedding color would be a good replacement.			X	X				X
1064	LAFB	3			During teardown, finding an increase of carbon buildup in combustor cans (conflict with AGE maintainers, diesel fuel vs JP-8, see below)	X							
1228	MHAFB	3			Interactive Video Disk (IVD) training should be made mandatory for all AGE users and maintainers.				X				X
1302	LAFB	3			Would like to see AGE with a better defuel capability. Some units must be sucked out with a transfer pump.	X				X			
1406	SEEIT	3			Maintainability (Material Induced): Poor paint, sheetmetal corrosion, metal fatigue and cracking, overstressed hinges or rivets, enclosures too heavy, too many fasteners are not captive, cracking plastic, warped or bent doors.			X					
672	NAFB	2			Tech data (T/0) could be cleaner; 10 - 12 T/0's required for trailer, one for each vendor, and differences don't warrant separate T/0's.				X			X	X
686	NAFB	2			General problem with gauges crazing in the sunlight; would prefer digitals.	X							X
687	NAFB	2			Night lights for small servicing carts are the only night problems.	X							X
688	NAFB	2			Clip light would help; something like a miners light (hot light) would be very good.	X							X
727	MHAFB	2			Short hoses are a general problem, lox and hydraulics carts could be 10-15 feet longer and low pac's could be 5 feet longer.	X							X
1135	MHAFB	2			Very difficult to safety wire anything while in arctic or C/B gloves.			X					
660	NAFB	1			Hoses: Prefer older type multi-layer rather than the newer single layer rubber because of the high weight of the latter.				X				X
211	PAFB			NR	Need more help like Gold Flag. It is a welcome help for non-DIFM items particularly				X				X
658	NAFB			NR	General concern is not being able to afford adequate quantities of some systems such as NF2, low pac, 60's, etc. which are in high use.				X				X
666	NAFB			NR	Use E-Mail to communicate with item managers.				X				X
667	NAFB			NR	F-15 bases have set up bulletin boards but have problems with information saturation (high volume) and lack of structure.				X			X	X
668	NAFB			NR	Circumventing T.O.'s is a potential problem.				X			X	X
669	NAFB			NR	90 -95% of actions require power and air.				X				X
670	NAFB			NR	Would like hose reels.	X							X
671	NAFB			NR	Prefer digital over analog gauges except for pressure setting.	X							X
676	NAFB			NR	Prefer to buy commercial so the spares/support are available.				X			X	X
677	NAFB			NR	Feel that local bases can do a better buy than the formal Air Force procurement system.				X			X	X
678	NAFB			NR	Liaison at Kelly helps considerably, suggest the same for all AFC's.				X			X	X
679	NAFB			NR	Procurement: Refer to only one person for procurement, feel they can do better shopping around.				X			X	X
680	NAFB			NR	Technology for conformal tank dollies was sold to Israel, now have to buy from Israel and expect another price increase.				X			X	X
681	NAFB			NR	Working groups are great (Chief Converse and Chief Ansell), but TDY funding hard to come by.							X	X
682	NAFB			NR	50% of maintenance associated with abuse and operator error, partly because they are pushed for time.	X		X					X
684	NAFB			NR	Availability of support equipment is generally in five minutes or less.				X				X
685	NAFB			NR	Little or no experience with self-propelled equipment, neutral to negative on it (more hardware to maintain).	X		X	X				X

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693	NAFB			NR	Any SE simplification would be helpful.	X	X	X					X
694	NAFB			NR	Aging: Little to no aging problems; equipment is well maintained or replaced to keep current.		X	X					X
696	NAFB			NR	General preference for digital displays.	X							X
699	NAFB			NR	Continuity: Nellis has civilians that retain continuity.				X				X
701	NAFB			NR	Troubleshooting wiring problems (e.g. lantirn): Use automatic capability; equipment self test does a test cable check, but does not account for equipment wiring problems.			X					X
703	NAFB			NR	Maintenance Improvement Program (MIP) review board is a periodic group session with Martin Marietta to explore problems and solutions; similar boards exist for the F-16, etc. These are favorably viewed as problem solvers.				X				X
704	NAFB			NR	PMEL automated data system is a local database for Nellis; not all data entered focuses on adjustments and peculiar issues.				X				X
709	NAFB			NR	Item Managers are not knowledgeable enough about their assigned equipment.							X	X
711	NAFB			NR	Parts sent by Federal Express instead of lower cost means.				X			X	X
712	NAFB			NR	Often have to buy parts locally in lieu of Government stock brands (but why not?).				X			X	X
717	KAFB			NR	Kelly suggests we talk to the Tech school (Shepherd).								X
718	KAFB			NR	They don't provision for commercial items by edict.				X				X
720	KAFB			NR	Mike Zander (WPAFB) has a world wide database on AGE Branch Chiefs (flight chiefs).	X			X				X
721	KAFB			NR	Hydraulic test stand RFP is a test case for the new rules and regulations on procurement. The fundamental problem is they can no longer develop their own specifications, they must use commercial specs except with an act of God.							X	X
723	KAFB			NR	E-mail helps.							X	X
724	KAFB			NR	Suggestion Path: Suggestions received from the field are processed with final decisions made by the Depot/Kelly. If the suggestion is rejected and resubmitted it must be disapproved at a higher level.							X	X
725	KAFB			NR	Next AGSEWG is 15 April and is expected to have comprehensive representation.				X				X
726	KAFB			NR	Each major piece of ground support equipment has a five year plan. Some of these are available from Lieutenant Schroeder who has copies on disk.				X				X
728	MHAFB			NR	There are several groups that support SEEIT objectives (to improve the SE). These groups include the product improvement working group, material improvement product review board, product management review (annual), job fair (annual- sqdn funded)				X				X
729	MHAFB			NR	There are constant updates in equipment and these are available from other bases through the E-mail.							X	X
731	LAFB			NR	Make all equipment user friendly.	X							X
732	LAFB			NR	Each base has their own views on how JP-8 effects their equipment when starting and stopping.				X				X
735	LAFB			NR	Suggested natural gas powered SE to meet environmental concerns.				X				X
736	LAFB			NR	Systems are burning diesel fuel not JP8 as indicated earlier.				X				X
737	PAFB			NR	T/A not enough equipment to work with.					X			X
768	NAFB			NR	AF item requires toxic gas to calibrate; alternate commercial non-toxic gas is available.				X		X		X
769	NAFB			NR	Must comply with OSHA reg's.				X		X		X
770	NAFB			NR	AFI's are so general they don't try to update and use their own internal system (their own mobility plan) issue attributed to training, if trained to do it right don't have to direct them to do it right.				X	X			X
1059	LAFB			NR	Troops want AGE to be simplistic & mobile								X

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1060	LAFB			NR	SE availability - 30-45 minute wait	X							
1063	LAFB			NR	ESD caps - Good for pin/dust protection, but are useless for ESD protection & very expensive (regulation calls for it)	X							
1065	LAFB			NR	Second group of AGE maintainers stated all diesel engines are running on diesel fuel at LAFB	X							
1141	MHAFB			NR	Use as much COTS as possible. Improves parts availability.				X			X	
1224	MHAFB			NR	When AGE requirements are being developed and during AGE acquisitions, the users and maintainers should be consulted to get best input.								X
1226	MHAFB			NR	Self propelled features on SE units are more stuff to be maintained. Fifty percent of all SE maintenance is a result of abuse or operator error.			X					X

Ground Power/Start Cart

-60 Generator Set

1298	LAFB	5			Exhaust emissions are way too rich....may still be combustible. The -85 fuel burn is good. (EPA issue)	X							
98	PAFB	4			Even on new engines from depot, the combustor cap where the ignitor plug goes in gets warped and leaks air. Requires Machine Shop to true them		X	X					
282	NAFB	4			EMI problem: interferes with radar if it gets too close to the aircraft; worse inside a bunker with metal walls.	X	X						
290	MHAFB	(4)	282		The cart has an EMI problem and interferes in the terrain following radar (TFR).	X							
919	LAFB	4			Fuel control filter (peanut) inaccessible, must remove fuel control to replace filter (2 hr MTTR)			X					
1272	LAFB	(4)	919		Peanut filter on fuel control and the oil filter are too difficult to access.			X					
920	LAFB	4			MT-1 box (governs fuel control) high failure rate item (6 failures in the past 4 months)		X						
1269	LAFB	(4)	920		Trim control slips off shaft. Also, replaced six MT-1 boxes (controls fuel control) in four months.		X						
1268	LAFB	4			Quill shaft on fuel control wear down/round off. Must pull fuel control to replace (approx 2 hours).		X	X					
918	LAFB	(4)	1268		Fuel control quill shaft wears down continually		X						
95	PAFB	3			Hoses can burn if thrown against the hot coupler	X							
921	LAFB	(3)	95		Need compartment storage for air hose	X							
1270	LAFB	(3)	95		Hose storage is too high. Can fall and hit somebody.	X					X		
96	PAFB	3			Likes unit but is very difficult to move around manually to position. Unit becoming obsolete because acft no longer need bleed air for engine start.	X					X		
99	PAFB	3			To perform inspections, must remove the cover, but the nutplates either turn or break off.			X					
283	NAFB	3			Would like more electrical outlets for general support.	X	X	X					
915	LAFB	3			Hose clamps difficult to hookup to the couplers			X					
917	LAFB	3			Main fuel filter sucks air due to seal misalignment (hard to install correctly)			X					
1267	LAFB	(3)	917		Main fuel filter sucks air all the time.		X						
922	LAFB	3			Over abundance of safety wire - troops cut hands/arms constantly	X					X		
1271	LAFB	(3)	922		Unit has too many safety wired components.			X					
923	LAFB	3			Metallic braided lines fray easily - troops cut hands/arms constantly	X					X		
1274	LAFB	(3)	923		High pressure lines fray too easily. Need to replace with a different material. Considered dangerous.		X				X		
924	LAFB	3			Accessibility of oil filter is difficult			X					
1273	LAFB	3			Enclosure is too heavy. Takes four people one half hour or a crane to remove it.			X					
289	NAFB	(3)	1273		Maintenance: must remove the whole top to access the -60's; very heavy.			X					
92	PAFB	2			Safety problem when fire shoots out the top of the unit. Is a common occurrence.						X		

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93	PAFB	2			Can accidentally turn the air on if person is not experienced (safety)	X					X		
94	PAFB	2			Air hose can become uncoupled and whip around (safety)						X		
97	PAFB	2			Petcocks in the back occasionally drip		X						
280	NAFB	2			Brakes jam and make it difficult to position.	X					X		
285	NAFB	(2)	280		Brakes jam and make it difficult to position.	X					X		
288	NAFB	2			High fuel consumption (190 gallon) considered a big problem.	X			X				
913	LAFB	2			Hot days - hard starting & turbine over temperatures occasionally		X						
1315	LAFB	(2)	913		Units sometime hot start (not often).	X	X						
914	LAFB	2			Safety - high decibels						X		
1197	NAFB	(2)	914		Noise levels with the -60 are too high.	X					X		
916	LAFB	2			Gauges are hard to read	X							
279	NAFB	1			Brakes are hard to engage.	X					X		
1181	NAFB	1			Some -60's bleed air is inadequate for engine tests. Need a -60 capability that is integral to the hush house. Have no problem with the MA1A air capacity.	X			X				X
91	PAFB	0			Diminish sound of horn that warns of low fuel (very startling). Horn is a good thing and gives you plenty of advanced warning	X					X		
286	NAFB	0			Air hose hook up difficult to remove when hot.	X					X		
281	NAFB			NR	High usage piece of equipment.								X
284	NAFB			NR	Usage: use at one hour shots, could be up to six hours (peculiar to Nellis because of level of testing).	X							X
287	NAFB			NR	Self propelled feature: removed because of accidents (unit moved when tongue brought down).	X			X		X		

-85 Generator Set (GPGS)

261	NAFB	7			Center bar on -85 hoses fall off and gets lost.	X							
259	NAFB	6			Difficult to position (very heavy).	X				X	X		
267	LAFB	(6)	259		-85 and -19 are tied together and hard to move.	X				X	X		
273	LAFB	(6)	259		Also mentioned, GPG being non-maneuverable and too heavy.	X				X	X		
926	LAFB	(6)	259		Difficult to move due to weight (7K lbs)	X							
929	LAFB	(6)	259		AGE truck, GPG bending hook side ways because of mass (similar to train effect)	X							
931	LAFB	(6)	259		Cumbersome when checking JFS on 30 jets, approx 2.5 hrs	X							
933	LAFB	(6)	259		Hard to maneuver, especially when AGE driver puts unit on wrong side of jet (power cord too short)	X							
937	LAFB	(6)	259		Fuel troops have to move unit bodily to fuel hangar, due to 50' stayout area - very exhausting	X							
1320	LAFB	(6)	259		Hooks on tow vehicles get damaged while towing this tandem. Too much slop.		X						
272	LAFB	6			GPG has air and power - if air quits you need to disconnect everything and then get a new GPG. If functions were separate - R&R would be easier.	X			X				
278	LAFB	6			Fuel tank filler neck is pressed in and doesn't seal right - causes gas leaks.				X	X	X		
939	LAFB	6			Can't reset CB - must call AGE to reset popped CB, mostly due to wrong sequence of switches	X			X				
944	LAFB	6			Fuel shutoff valve leaks frequently - (3) failures week of 5/17/96		X						
1299	LAFB	(6)	944		Fuel shutoff valves have leak problems (approximately three times per month).		X						
1227	MHAFB	6			Hate -85s for ICTs. They take too long to set up/get ready. There is already too much going on in a rush.	X							
260	NAFB	5			Storage compartments are very compact; difficult to store hose and power cords; recommend external hooks.	X							

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266	LAFB	(5)	260		Some -85 units bleed air hoses had been cut shorter so they would fit in the storage bins.	X			X				
268	LAFB	(5)	260		All compartments on -85 are too small.	X							
271	LAFB	(5)	260		GPG - bleed air hoses are too short - they have been cut to fit into storage compartment. GPG's are too bulky - can't move them around like the -60. .	X					X		
277	LAFB	(5)	260		Cut GPG hose from 30 ft. to 15 or 20 ft. Hose was not fitting in storage area. Users were jamming it in and cracking door.	X			X				
927	LAFB	(5)	260		Stowage of cord/hose very difficult due to small storage compartment	X							
935	LAFB	(5)	260		Users have noticed shorter bleed air hoses on some units (see below)	X							
936	LAFB	(5)	260		AGE maintainers have cut air hose in half (15'-20') due to bulging doors & latches breaking	X							
1260	LAFB	(5)	260		Storage door brackets crack.		X						
1316	LAFB	(5)	260		Units work good. Positioning and hose storage are problems.	X							
270	LAFB	5			GPG power cord is on the wrong side - have to swing around to other side to get to jet.	X					X		
1336	LAFB	(5)	270		Power cord is on the wrong side of the unit.	X							
930	LAFB	5			Many battery failures, possibly due to hot weather		X						
1326	LAFB	(5)	930		Unit seems to go through batteries quickly.		X						
1331	LAFB	5			Unit is too difficult to know how to use properly, especially when you need to use air conditioning. (Even after training classes.)	X			X				
932	LAFB	(5)	1331		Difficult to operate	X							
1121	MHAFB	(5)	1331		Backshop is not too familiar with the unit. Could use diagnostics/ops instructions on the panel.	X		X					
1319	LAFB	(5)	1331		If you get out of sequence while trying to start unit, it won't start.	X							
262	NAFB	4			Tow bar is awkward, must be lowered nearly to the ground to release the brakes and move.	X					X		
1119	MHAFB	(4)	262		The -85 is too large and towbars must nearly be down to the ground level to use. Unit also has bad storage space for hoses and cables.	X							
263	NAFB	4			F-15 cooling air adapter blows off when roll pin is worn or damaged.	X					X		
274	LAFB	(4)	263		GPG D-model adapter doesn't fit very well - otherwise liked GPG!	X		X					
938	LAFB	(4)	263		F-16Ds, air hose adapter (chicken neck) doesn't fit properly - jet female connection different configuration	X							
1362	LAFB	(4)	263		Air adapter (chicken neck) doesn't fit the D models that well. The C models are okay (angled). Also, air hose knobs are breaking off.	X	X						
276	LAFB	4			GPG battery compartment - poor layout - difficult to R&R batteries.			X					
941	LAFB	(4)	276		Battery compartment is a maintenance nightmare - very difficult to R&R or check battery			X					
1264	LAFB	(4)	276		Battery compartment design is poor. Must remove first battery in order to check the second.			X					
942	LAFB	4			Oil filter housing, if over torque could break housing			X					
1265	LAFB	(4)	942		Oil filter housing cans strip or break off. May be getting over torqued.		X	X					
1094	MHAFB	4			The -85 has no output (connection) for test sets. (The -60 does.)	X							
264	NAFB	3			Difficulty troubleshooting simple problems because of the lack of familiarity with the equipment.			X	X				
265	NAFB	2			Units take too long to come on-line.	X							
269	LAFB	(2)	265		GPG vs. -60: GPG takes too long for air to come on.	X							
934	LAFB	(2)	265		Air takes a long time to come on-line	X							
1120	MHAFB	2			Hoses wear out on the end (rubber collar). Couplings go bad and cause hoses to blow off (especially the F-15).	X	X				X		
275	LAFB			NR	GPG are supposedly more fuel efficient than a -60.	X			X				
925	LAFB			NR	Unit is being eliminated (GPGS) (50-60 units)				X				
928	LAFB			NR	Troops would rather have -60 for maneuverability	X							

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940	LAFB			NR	AGE monitors fuel consumption of -60 vs GPGs; operating duration, -60 (6) hours & GPGs (10) hours - Fuel tank capacity, GPGs 40 gals larger								X
943	LAFB			NR	AGE maintainers permanently attached TO line (power line to air conditioner) to both units - cables were getting damaged (cured problem)	X	X						
1233	MHAFB			NR	Was a -85 test site. Preferred the Ingersoll Rand unit over the one that was selected.								X
		-86 Generator Set											
87	PAFB	8			Shutdown cable goes across the hot output terminals, which are connected to a panel. When the clamp breaks or the cable is pulled, the cable touches the backside of the panel and arcs. Fire emits from that area	X					X		
76	PAFB	7			Towbar latch fails and allows towbar to fall on people. They get severely injured on the head, back and feet. Wears out too quick. Mechanism is too small for the job it is trying to do. Needs a meatier latch		X				X		
474	MHAFB	(7)	76		-86 tongue vibrates while towing and sometimes falls to the ground (considered a safety issue).						X		
78	PAFB	7			After one week, water pumps leak around the shaft seal. Detroit-supplied pumps leak right out of the box (have made an in-shop tester to test them). Three QDRs submitted 1 year ago, but status unknown. Failures comes in batches		X		X			X	
79	PAFB	7			New radiators from base supply leak around the hose fittings. Must have them welded before installing them. Many are failing on the flightline		X		X				
83	PAFB	7			Newer units are single bearing generators and are more unreliable. Results in dust intrusion, cracked seals and causes fields to crack. Failure difference of 10 to 1 between the old and newer units. Older units also had a covering on the back which helped		X						
84	PAFB	(7)	83		In the newer single bearing units, the weight of the front half of generator rests on the main crank bearing, causing main bearing oil seals to go out. Can use double bearing part in the single bearing units		X						X
85	PAFB	(7)	83		Can occasionally get the two bearing part from supply when they have them. When the bearing is issued, must order the special adapter plate and bolts to complete the installation. Often goes MICAP for the adapter plate and bolts			X	X				X
88	PAFB	7			Output cables are routed over the top of the generator and across the control panel. They chafe and wear against the bolts which hold the accessories to the top of the panel. Cables need more chafe padding due to vibration of diesel engine.			X			X		
74	PAFB	6			Fenders are too heavy for the bolts that are used. Fenders will fall off when towing the unit. When hit by a tow tractor, fenders didn't dent but bolts broke and fell to the ground		X						X
480	PAFB	(6)	74		Fenders fall off.		X						
89	PAFB	6			Non-metallic fuel tanks on the -86 constantly leak at the top.		X				X		
90	PAFB	6			The fuel pick-up line was sucking up the bottom of the tank and cutting off the fuel flow.		X						
1155	NAFB	6			Cork type seals that are used for items on the fuel tank tend to leak after a while. This is a HAZMAT concern.		X	X	X				
55	PAFB	5			Usually run for 8 hour periods, but unit does not hold up very well under those conditions. Circuit cards usually burn up		X						
56	PAFB	(5)	55		Avionics people were forced to repair -86 circuit cards during Desert Storm		X		X	X			X
59	PAFB	5			Frequency and voltage fluctuations too great, a constant problem. Happens most often after a rain. Small relay is the problem.	X	X						

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
52	PAFB	(5)	59		Power and frequency fluctuates and unit smokes	X	X						
61	PAFB	(5)	59		Have a hard time getting the A-10s to accept the newer -86 units with the single power cord. Sometimes go through 3 or 4 power units before the aircraft will accept it	X	X						
66	PAFB	(5)	59		After the aircraft rejects the ground power, sometimes just resetting the red fault lights on the older -86s will cure the problem.	X	X						
67	PAFB	(5)	59		DC packs get wet (circuit cards) in the rain and then the power won't come up.		X						
69	PAFB	(5)	59		Voltage regulators have numerous problems. The resistors, the cards, the transistors and diodes all go out. Go through a lot of regulators and a lot of time is spent fixing them.		X	X					
71	PAFB	(5)	59		Just towing the unit can cause the door to pop open. This door is the access point to the overload cards. Bad latches		X						
72	PAFB	(5)	59		Sheet metal fastener holes located directly above the overload cards allow collected water to drip through to the overload cards. Six to 8 units come in for repair after a rain. It's a design error, but sealant would cure problem		X	X	X				
468	NAFB	(5)	59		Recommend sealed boxes for electric's (open and collect dirt and moisture).		X	X					
471	MHAFB	(5)	59		Frequency adjustment on 400 Hz is a problem, must readjust on flight line (may be a gauge issue).	X		X					
479	PAFB	(5)	59		-86 (overload cards get wet and need to be moved).		X	X			X		
1235	MHAFB	(5)	59		Put plastic box over K4 overload card to prevent water intrusion. Don't use them much.			X					
70	PAFB	5			Overload cards get wet, probably due to their location (water intrusion). Causes Redball situations. When pressurized air is used to dry them out, the unit will come back up. Bad door seal.		X						
73	PAFB	(5)	70		Overload cards and plug-in area get wet and short out . Suggested a Plexiglas cover be installed, but it was turned down. Plastic bagging the cards was also suggested. Need to completely enclose the card and position it on its side to dissipate the water.		X						
75	PAFB	5			Battery-charging box doesn't charge battery until the generator gets up to on-line speed. The battery runs the panel lights and starter unit, but isn't charged at idle speed. Going back to old mechanical alternator solved problem as it charges at idle.		X						X
481	PAFB	(5)	75		Battery charging system is no good because it takes too long to charge up. Trickle charge.		X						
77	PAFB	5			Overspeed governor works loose at the back end and wears the shaft. When the centrifugal switch moves, it causing the unit to trip off line.		X						
80	PAFB	5			Location of the low coolant sensors trips the unit constantly. Although a safety circuit, if the sensors are uncovered just by a small fraction, the unit trips. This is needless. Sensors need to be relocated. Better yet, eliminate them			X					
81	PAFB	(5)	80		Low coolant sensors in old-style radiator are located lower than in the newer radiator. When filling newer ones to 1 1/2 inches below the filler neck (TO spec), the sensors will trip the unit off	X			X				
82	PAFB	5			Relays in the trays are mounted so that the wires are lower than the tray. Removal of relays causes wires to break due to back and forth movement. Must resolder wires. Sockets also get easily worn out. Need higher mounting or different mounting		X	X					
51	PAFB	4			Difficult to position (very heavy).	X							
58	PAFB	(4)	51		Would like the unit to be self-propelled. Too many backs are being injured pushing these units around. Patented design with deadman switch is available to DOD	X					X		X
476	PAFB	(4)	51		-86 hard to move.	X					X		
478	PAFB	(4)	51		Would like heavy units to be self-propelled.	X							X
60	PAFB	4			Analog freq and volt meters are hard to read and are of questionable accuracy. Accurate digital readouts would prevent A-10 aircraft from rejecting the power unit	X	X						
86	PAFB	3			The exhaust system wet stacks, just like the MC-1A compressor, and causes all sorts of problems. Can load bank the unit and let it run at a higher speed to burn out the problem	X		X					

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
469	NAFB	(3)	86		Problems with engine wet stacking on JP8 fuel.	X			X				
1154	NAFB	(3)	86		Unit has a problem with wet stacking. Suspect problem could be caused by use of JP-8 fuel vs diesel. Build-up must be cleaned.	X		X					
1153	NAFB	3			The -86 is a good generator but is hard to start. Currently use ether to aid in starting but would like to see an inlet heater or equivalent.	X	X						
472	MHAFB	(3)	1153		Not all 86's have the ether start system and are thus hard to start in cold weather.	X							
1236	MHAFB	(3)	1153		The -86 cold weather start kit didn't work (blew fuses). Took them off and use ether.	X		X					
1237	MHAFB	3			Need access panel to get to control panel. Currently is time consuming (15-20 minutes extra).			X					
1238	MHAFB	3			Unit can vent fuel while filling if not careful or gauge is incorrect.				X				
53	PAFB	2			Needs easier kill switch. Requires pulling out T-handle and holding it out forever	X	X						
64	PAFB	(2)	53		After unloading the power, sometimes it takes forever for the unit to come back to idle. Sometimes it never does idle, which forces troops to use the emergency shutoff. Usually the next user tries to start the unit with the emergency shutoff still employed.	X	X						
57	PAFB	2			The six-wire power cable (1/2" dia.) is disliked. The plastic clamps holding the 6 wires wear out on the ramp pavement, then break or else they slide up next to the power unit. Duct tape is a poor fix. Single sheath cable is the way to go.	X	X						
54	PAFB			NR	C-130 operations need more Hobarts. Too much maintenance delay waiting for this unit.	X							X
62	PAFB			NR	Seems to be a shortage of -86 units in A-10 squadrons				X				X
63	PAFB			NR	A-10 doesn't need the DC packs on the -86 units, but they come in handy to jump start other pieces of AGE	X							X
65	PAFB			NR	Unit is much quieter than a -60, plus the fan provides warmth in cold weather.	X							X
68	PAFB			NR	Voltage is not adjustable to the user, although they often adjust the frequency to get the aircraft to accept the power.	X							
467	NAFB			NR	Reliable carts.								X
470	NAFB			NR	Fiberglass fuel tank leaks.		X						
473	MHAFB			NR	Hard to operate with winter gloves, solved problem by opening the door.	X			X				
475	PAFB			NR	-86 single sheath great.	X							X
477	PAFB			NR	Single sheath cable is great on -86 cart.	X							X

-95 Start Cart

227	PAFB	6			Has non-metallic gas tank. Experiences leaking problems during deployment. Replacements are coming in.					X	X		
868	KAFB	(6)	227		Polymer fuel tank design problem. Swelling of plastic tank causes unusable fuel (135 gal tank, can use only 85 gal)		X						
291	NAFB			NR	Does not put out enough air to start the engines (use identical engine to -60's, therefore will have identical performance); use two carts with a y-duct when necessary; 85-180C is borderline (J model upgrade).	X							
292	KAFB			NR	First procurement was a development configuration with problems (e.g. insulation, bleed air ducts breaking, fuel tank, replace Ni-Cad batteries with Optima gelled batteries etc.)		X						
293	KAFB			NR	There are many design changes for the second buy including the fuel tank which was dropped from 130 gallons to 85 gallons (3 hour run time was in the original requirement.)	X			X				
869	KAFB			NR	New LASS units have incorporated lessons learned. Polymer fuel tanks converted to steel. Batteries changed from Ni-Cad to Optima (better charging). New coupler added to bleed air ducting due to ducts blowing off		X						
870	KAFB			NR	MA-1A in wearout phase, LASS is replacing these old start carts								X

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
MA-1A Start Cart													
226	PAFB	6			Units frequently flame out or shoots out fire. -95 is the scheduled replacement	X					X		
228	PAFB	5			Bonding wires on ducts are not durable and wear out. Ducts are hard to connect and keep connected.	X	X						
225	PAFB	3			Used specifically to purge fuel tanks, however ducts are difficult to connect and don't stay connected. Spare ducts are needed for C-130 work. Units are archaic and not very portable. Duct storage is a problem on them (wire system). Unit not towable.	X				X			
MASS													
830	NAFB			NR	Concern with multi-function cart is man-power waiting because all the functions are in one spot and cost will prevent sizable quantities from being procured.				X				X
831	NAFB			NR	Opportunity: Weight and balance must be provided for each piece of equipment; this could be done automatically (could be standardized as part of the chassis for all mobile equipment).				X	X			X
832	NAFB			NR	Concern in not being able to afford the quantities of some key systems that are high usage such as NF2's, Low pac's, -60's, etc.				X				X
833	NAFB			NR	Would like a vacuum (cleaner) on MASS.				X				X
834	NAFB			NR	Concern over single point failure - if modular, partly or largely resolved this issue.				X				X
835	NAFB			NR	Customs holdup on equipment shipping maybe higher for MASS because of the nooks and crannies that can collect dust; are not shrink-wrapping some equipment.				X	X		X	X
836	NAFB			NR	Would like on-board troubleshooting instructions (computer based).			X	X				X
837	KAFB			NR	Single point failure is seen as an issue.				X				X
838	KAFB			NR	Deployment is a plus (small footprints).					X			X
839	MHAFB			NR	Use pressure intensifier made by Futurecraft (in the City of Industry, CA).				X				X
840	LAFB			NR	Combo of light/air/electric would be most useful piece of equipment.	X			X				X
MD-4 Generator													
243	PAFB	6			Unit has a history of shooting sparks and fires (safety)						X		
1104	NAFB	2			MD-4 generators are too noisy. Would like to see them replaced with EPU-6/E frequency convertors. These are very quiet and the voltage detect/control is very reliable. POC for this is Dave Brower (ph 800-933-4053)	X	X						X
MEP-105 Generator Set													
222	PAFB	3			A fuel bladder hookup is desired. These units are often run 24 hours per day and must be stopped twice daily to refuel. Some of the ECM system tests are 8 hours in duration, and any interruption requires the test to be started from the beginning	X				X			
221	PAFB	(3)	222		Fuel tanks could be larger or the engines made more fuel efficient. Or recommend fuel bladder hookup which would permit operation for multiple days	X				X			
223	PAFB	3			Electrical output connector is a single feed internal hook-up. A second output bank is desirable, as both shops could be run from a single MEP	X				X			
219	PAFB			NR	Power is very stable and clean, but the unit is quite heavy	X	X			X			
220	PAFB			NR	ECM shop had one unit that shot up instantaneously to 240 Volts and blew all their fuses in the shop		X						

Gun/Loading

Gun Jam Kit

ID	Loc	SevFac	Ref		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
772	LAFB			NR	They have developed a hot gun kit which includes essential tools only and allows them to get to the aircraft before the fire department. Saves a lot of time.				X		X		X
1072	LAFB			NR	Armament has devised a mini hot gun kit for gun jams, saves a lot of time & they even beat fire trucks to jet - existing kit is too large & bulky	X							

Gun Stand

1129	MHAFB	3			The gun stand (used for R&R and maintenance) needs to be designed better for support. The gun falls over when the barrel is removed. Currently use a bar to prop it up (200 lbs).	X		X			X		

UALS

638	KAFB	7			Jamming is the biggest problem and it breaks parts. Appears to be connected with gear timing (not quite in time when the shell is handed off).	X	X						
647	MHAFB	(7)	638		Jams regularly and they end up hand loading the ammunition.	X	X	X					
651	MHAFB	(7)	638		Air Force didn't buy dummy ammo (jamming/tearing up shells).								X
652	MHAFB	(7)	638		F-15 gun system jams on loading.	X	X						
846	KAFB	(7)	638		Jamming causes: PGU-27 round, goes in a nose up attitude (CG problem) - Jamming in gear mesh area thus causing parts to break		X						
1047	LAFB	(7)	638		Numerous jams due to timing - TCTO coming out to cure 50% of jams (slow coming), armament has implemented belt rerouting with great improvement				X				
1116	MHAFB	(7)	638		PGU-27 ammo must be loaded manually due to the round's nose weight. Many instances where the case has been gouged causing loose powder. PGU-27 ammo has been in service about one year...used M-55 series prior to that.	X							
1118	MHAFB	(7)	638		Reportedly, personnel can't adjust the UALS properly because the USAF never bought dummy ammo. (The Navy did.)			X	X				
1358	LAFB	(7)	638		Belt twist to make UALS compatible with F-16 causes timing problems between the drum and loader head. TCTO says to put twist between head and drum. New TCTO due out soon should cut down on half the jams.	X	X						
1048	LAFB	7			Lower canvas cover collects debris - FOD problem - Maintainers at MHAFB & LAFB state lower cover is not really needed						X		
644	MHAFB	(7)	1048		Cover traps dust and dirt.	X			X				
1130	MHAFB	(7)	1048		The UALS picks up all kinds of junk and deposits it elsewhere. The bottom cover of the unit is useless. A tarp would do better.	X			X				
1061	LAFB	7			Flex drive that manually turns the gun sys remotely, (4) have come apart violently and have injured several troops (personally saw a gash from nose to lip)		X				X		
653	LAFB	(7)	1061		UALS flex drive for ammo cycle slips out of the socket and hits you in the face.		X				X		
1360	LAFB	(7)	1061		Have had four flex drives come apart (cracks at socket). Dangerous - parts can hit face. May need lock pin or something.		X				X		
637	KAFB	5			Dust collected by the gear lubricant is a problem causing jamming. They're looking at a new lubricant (TW25B).	X	X	X					
648	MHAFB	(5)	637		Has greased open gears which gather dirt.	X	X	X					
845	KAFB	(5)	637		Grease congeals - presently testing TW 25 grease (from F-15 program), repels dirt and sand		X						
1115	MHAFB	(5)	637		Units have exposed gears which require lubrication and are no good in sand/dust areas. Must use by-pass to load due to gear problems.	X	X	X					
1357	LAFB	(5)	637		Doesn't like to work well in sandy and dusty environments.	X							
645	MHAFB	5			Maintenance is intensive, the unit is unreliable.		X	X					

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646	MHAFB	(5)	645		Parts are considered cheap.				X				
650	MHAFB	5			Replenishers (replenishes UAL) can't get parts (20mm), has too many moving parts.		X	X	X				
1117	MHAFB	(5)	650		The 20MM replenisher is too complicated and has too many parts.	X	X	X					
1114	MHAFB	5			Fiberglass scoop disk is a bad design. The older ALS has metal. The TCTOs that are out to resolve many UALS problems are not that good.	X							
640	KAFB	3			Our problem's with the interface with the F-15E. (Linkless system - different configuration.)	X							X
639	KAFB			NR	They took a loading system on the gun which is fast and eliminates the effect of gravity; the adapted loader may be operating too slow for it.	X							X
641	KAFB			NR	A new unit has been developed and has demonstrated 220K rounds without a problem. It holds 2100 rounds, the same as the current unit. It uses different technology and is simpler (merges three lines of ammo into one).	X			X				
642	KAFB			NR	Current UAL's will remain in the inventory for some time, thus need improvements.	X	X	X	X				
643	MHAFB			NR	There is a replacement for the UAL available (LAW) which is reported to be greatly improved.	X	X	X	X				
649	MHAFB			NR	Have 19 units.				X				X
847	KAFB			NR	Old units are being purged with new/simpler unit, estimate 2 year replacement		X		X				

Heater

H-1 Heater

134	PAFB	7			Fumes in the hot air output are overwhelming when used in a confined area (C-130 bay)	X	X		X		X		
137	PAFB	(7)	134		User wants maximum heat and turns unit up to 250-260 degrees. On shutdown, he doesn't allow for cool down. Heat exchangers crack as a result. User abuse. Maybe a training problem	X	X		X		X		X
132	PAFB	4			When burner goes out, fuel sometimes continues to flow and reignites		X				X		
131	PAFB	(4)	132		Catches on fire due to fuel overflowing into burner after shutdown		X				X		
133	PAFB	(4)	132		Fuel metering is not consistent from unit to unit. Some must be turned to max to only get a small flow, while others can be turned off and still get a correct flow.	X							
139	PAFB	(4)	132		Burner always clogs up with carbon and soot. Fix is to soak burner, but it only lasts a couple months. Needs a can that either breaks down or something that doesn't produce the carbon. Perhaps an electric element. Too much work on a heater			X					
140	PAFB	(4)	132		Overall, less problems with old style unit with the manual temp control and burner control. However, some burner control valves would constantly hang-fire. Recommended using new style on/off valves (a fuel control solenoid), but was disapproved by USAF		X						X
138	PAFB	4			AGE maintainers want an easily removable engine. Perhaps could mount it higher			X					X
959	LAFB	4			H-1, electronic fuel control - when they were new, worked great, with age they start accumulating problems		X						
1301	LAFB	4			If the electronic ignitor on the newer units goes bad it can't be adjusted (too technical). Feel this design is an over kill.		X	X					
136	PAFB	3			Hard to start when unit is left outside in the cold. Won't restart in cold after it is shut down for 1-1 1/2 hours	X							
562	NAFB	(3)	136		Extreme cold can't get heaters to start up at 0 deg F or below.	X	X						
563	NAFB	(3)	136		Virtually nothing starts at cold temperatures except the -60; hand heaters are no good, they blow out cold air.	X							X
1300	LAFB	3			Newer heater nozzles seem to be bad. Older one worked better. Luke AFB ops checks the heaters more than they use them.		X						
135	PAFB	2			Needs better internal lighting to find on/off switch at night. Vibrating and moving parts make fingers feel very vulnerable, even with flashlight. Present lamp is inadequate	X					X		
565	PAFB	(2)	135		Need light inside of new heater unit.	X		X					

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1173	NAFB	2			Heater automatically goes into an overtemp condition. Suspect it is not cold enough at Nellis to use these heaters properly.	X							
564	KAFB			NR	Warner Robbins is responsible for heaters.				X				X

Hoist/Slings/Cranes

Cobra Crane

577	NAFB	6			Crane for changing radar antenna or canopies (031) are top heavy and dangerous.	X					X		
579	NAFB	3			Hard to position.	X							
1196	NAFB	(3)	579		Positioning cobra crane is sometimes difficult. Can't do two-seat F-15 (too high). Also, motor will burn out if used for longer than 15 minutes.	X	X		X				
576	KAFB			NR	Warner Robbins is responsible for cranes.				X				X
578	NAFB			NR	Used to remove canopies, service radar etc.	X							X
580	NAFB			NR	Have new manual crane that is much easier and faster to use: In test phase, can be used on all weapon systems.				X				X
581	NAFB			NR	Cobra can't be used on A10's, F-15 C's and 2 seater F-16's.	X							X
955	LAFB			NR	Availability problem for armament shop - when L/H fuel tank installed, can't use jammer per T/O - crane must be used to remove gun/drum (egress has priority)				X				

Hoist

883	KAFB			NR	Hoist (miss application problems) - Fish pole commercial hoist for C-17 - used for life rafts and weight was too much for hoist thus damaging several units. Presently in redesign	X							

Slings

612	KAFB	2			There is a proliferation of slings because each piece of equipment calls out a special sling.	X			X				
882	KAFB	(2)	612		Slings are an area where proliferation is used, i.e., when SERDs are generated, engineers investigate fielded applications and recommend its use								X

Winches

884	KAFB			NR	Winches managed by Warner Robins ALC								X
885	KAFB			NR	Usually sole source due to many requirements for hangar use (explosion proof)								X
886	KAFB			NR	C-5 winch - used as a backup to remove engines/pylons	X							

Hydraulic Equipment

-6 Cart

352	NAFB			NR	-6 Hydraulic Cart to do radar only is not a problem.	X							X
354	NAFB			NR	-6 Cart: Want 3000 psi but puts out only 2500 psi, plus higher flow to use on other functions (e.g. a mini mule).	X							X
1092	MHAFB			NR	The -6 cart can't be used on the F-15 radar because it only goes to 2500 psi. Would like to have unit like this that goes to 3000 psi to do all utility things.	X							X

AV834 Hydraulic Test Stand

372	MHAFB	5			Stationary hydraulic test stand is complex (can make mistakes) and is considered to have safety hazards. Would like one that is more compact and fewer dials.	X					X		
1099	MHAFB	(5)	372		Hydraulic component test stand is 1950's vintage and is getting pretty dangerous to operate. (TO 33A2-2-51)	X					X		
1101	MHAFB	(5)	372		Would like to see the quick disconnects removed and stainless steel lines used to the crash box. Hoses are in the way of the eye wash station.						X		X

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374	MHAFB	2			AV tech test stand (AV834) is noisy and makes communications difficult.	X							
1217	MHAFB	(2)	374		Test stand is too noisy.	X					X		
373	MHAFB			NR	Does not deploy.								X
1216	MHAFB			NR	Some concern over whether the test stand is adequate for B-1 test pressures.	X							

Hyd Pumping Units

860	KAFB	3			Only problem is leakage at quick disconnect		X						
859	KAFB			NR	Used on large jets (KC-135, B-52, etc.) for pumping up jacks								X
861	KAFB			NR	Procuring 104 new units with diesel engines (HECO), deliveries will begin June 96 at rate of 10 per month								X

Hydraulic Equipment (General)

327	KAFB	4			They have about 25 different hydraulic stands in the inventory and about 15 R3 system stands. They want to reduce these to 2.								X
1225	MHAFB	(4)	327		Feel there are too many different types of mules. Would like to see one type capable of 1-3 system outputs, 4500 psi, and small diameter 30 foot (lighter) hoses with take-up reels.				X				X
324	KAFB			NR	Kelly does all field and some depot work on hydraulic equipment.				X				X
325	KAFB			NR	Kelly is working on a hydraulic test stand specification and RFP (test case for a commercial type procurement) now looking for a 3-system stand for the F-15, F-4, and some small systems. MTBF is 1000 hours on the total systems based on industry numbers.		X						X
326	KAFB			NR	Back shop unit is the second requirement in the works and then RFP has been issued.								X
328	KAFB			NR	They are asking for an FMECA analysis and test criteria to substantiate the predicted MTBF, MTTR etc. They plan to run 1000 hours on two units and intermittently on two others.		X						X
329	KAFB			NR	They will take equipment from three systems and make two systems, targeting 80% commonality. Previous proliferation was caused by spec control procurement in lieu of drawing control. The requirement is for 6000 psi max pressure.				X				X
330	PAFB			NR	Mules, two systems are OK.	X							X
862	KAFB			NR	Includes an option for the two system HTS as part of the three system procurement package, these will include diesel and electric motors for each option								X
863	KAFB			NR	Includes R&M requirements in procurement specification, e.g., MTBF of 1000 hours for the total system								X

MJ2 Mule

361	LAFB	7			Need to spring load or better latch the tow bar on the mules.	X					X		
102	PAFB	6			Too many mules leak, even before they are hooked up to the aircraft. Happens too often. Leaks are considered a Hazmat incident, which must be mopped up with special rags, creating even more of a Hazmat waste disposal problem		X						X
333	NAFB	(6)	102		Hydraulic hookup has a sealing problem which is inconsistent, sometimes no leak at other times a heavy leak.	X	X						
350	NAFB	(6)	102		Mule is messiest to hook up.	X							
359	LAFB	(6)	102		Hydraulic units leak and drip.	X							
1005	LAFB	(6)	102		Safety problem - Leaks hydraulic fluid on user						X		
331	NAFB	6			Maneuverability: most difficult to position; not self propelled, usually requires three people to move; hard to turn.					X			
1002	LAFB	(6)	331		Hoses not long enough to hookup systems A & B at jet, must maneuver (cumbersome) unit in place	X							
332	NAFB	6			Messy to operate.	X							
104	PAFB	5			Quick disconnects get bent or stripped and won't hook up to the aircraft	X			X				

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
114	PAFB	(5)	104		Needs a better design for quick disconnects. Even with the caps on, the new ones leak. This is an environmental hazard now. Unit looks bad with plastic bags over the QDs. Leaks risk contamination of the aircraft		X				X		
334	NAFB	(5)	104		High maintenance item: fails frequently.		X	X					
347	NAFB	(5)	104		Mules have low reliability, leak, and problems controlling pressure.	X	X						X
1001	LAFB	(5)	104		QD connectors leak at extension fitting	X	X						
1318	LAFB	(5)	104		Hoses could be longer. Connectors get beat up. Extension hoses leak at disconnects.	X	X						
105	PAFB	5			Dead batteries on the mule are frequent occurrences. Aggravated by both hot and cold weather		X		X				X
108	PAFB	5			Frequently have a lot of bubbles in the flowmeter. Represents a leak in the mule's suction line when it sucks air instead of hydraulic fluid	X	X						
107	PAFB	(5)	108		Units should be able to bleed the aircraft in the stand position. This is a malfunction condition in the mule	X	X						
1015	LAFB	(5)	108		Volume control (closed loop system) develops many leaks (1 failure every 2 months), therefore unit loses prime - 2 hour MTTR to reprime 3sys		X	X					
1330	LAFB	(5)	108		Unit puts too much air in the hydraulic system.	X							
111	PAFB	5			Mules are the hardest/most complicated piece of SE to use on the flightline. Many people don't know that hydraulic volume can't be set while pressure is on the aircraft.	X							X
112	PAFB	(5)	111		A lot of operator error due to lack of training. Write-ups are often erroneous (nothing wrong with the unit). Many users want the unit to pump 30 gallons per minute, but not aware that any aircraft requires that much volume	X			X				X
119	PAFB	(5)	111		Users often shut the unit down leaving the flow control valve open. This dumps the aircraft reservoir fluid into the mule, causing a spill	X							
115	PAFB	5			Low pressure filter housing was cracking on the newer units. Problem supposedly solved by putting bolts all the way around instead of a ring clamp		X						
1016	LAFB	(5)	115		Hyd low pressure filter takes extremely long time to R&R due to 12 allen wrench type bolts			X					
1275	LAFB	(5)	115		Don't like the use of allen screws on the low pressure filters.			X					
118	PAFB	5			Users often have the selector valve partially in, causing unit to be in both "aircraft" and "stand" position. This causes the mule to take on the aircraft hydraulic fluid during a service check. Mule overfills and dumps fluid overboard through the vent.	X							
100	PAFB	(5)	118		Biggest problem is the selector valve for selecting either aircraft or unit reservoirs. Regardless of the setting, it will suck the aircraft reservoir dry. Selector valves are worn out	X	X		X				
999	LAFB	(5)	118		Servicing problem - User inadvertently leaves selector valve partially "in", causing unit to be in both aircraft and standby positions - Mule takes on jet hydraulic fluid during the service check & thus overfills/dumps fluid overboard via vent	X							
1091	MHAFB	(5)	118		Seems there is always one broken control valve on the hydraulic cart. Controls are the biggest problem, particularly with the older units. Would like to see simplified controls.	X	X						X
120	PAFB	5			Brake system on the older units not sufficient for that heavy of a unit. Okay on flat terrain, but on a slope the units will creep away	X					X		
1003	LAFB	5			Insufficient GPM output for F-16 block 42, when checking flight controls or leading edge flaps must start engines	X	X						
1327	LAFB	(5)	1003		Can't use for F-16 blk 40 and 42 flight controls. Won't pass gpm BIT test. Must run aircraft.	X							
1017	LAFB	5			New Hydraulic International units, getting wrong parts when ordering parts from TO				X				
1078	NAFB	5			High pressure filters are very difficult to get to. Nut sometimes gets torn up.			X					
109	PAFB	4			Only one mule on base that they really want to use (a newer one). The other units are in poor condition. Parts are hard to obtain				X				X
113	PAFB	4			Too many different models exist on the flightline. Makes it hard for the AGE mechanic			X	X				X
343	NAFB	4			Maintenance difficult because of design, e.g. have to take the side and top off to change the bulb for the gauges; Filters hard to get at.			X					

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
358	LAFB	(4)	343		Light bulbs are hard to replace. .... A panel needs to be removed to change them.			X					
369	LAFB	(4)	343		Mule flowmeter panel is extremely hard to get to. Must change every couple of months. Need to crawl behind engine to change a light bulb.		X	X					
371	LAFB	(4)	343		Back panel needs two people for removal.			X					
1010	LAFB	(4)	343		Flow meter panel lights difficult to access - 1 failure/2 months			X					
1012	LAFB	(4)	343		Removal of roof & side panels takes excessive amount of time - 0.5 hours			X					
1013	LAFB	(4)	343		Flow meter light difficult to R&R due to muffler blocking access			X					
1164	NAFB	(4)	343		Indicator lamp replacement (both PC and utility) require that the unit be torn apart.			X					
1157	NAFB	4			Having difficulty receiving the new retrofit for the pumps (problem with priming and boost pressure switch). Have been on order for over six months.							X	
1229	MHAFB	4			Mules with Detroit diesel engines need common spin on filters.			X					
1245	LAFB	4			Can't get some of the parts yet for the new Hydraulics International unit (I.e., fuel pump, radiator cap).				X				
101	PAFB	3			Many users believe the bypass valve is used to adjust the hydraulic pressure. Should use the compensator valve. Represents a training problem, but could be mitigated with user placard	X			X				X
116	PAFB	3			AGE maintainers believe the users -6 cards do not tell them how to properly pre-set up the mule for the aircraft. Only tells them the proper pressure to use	X			X				
335	NAFB	(3)	116		Can overfill, needs an overflow tank.	X		X					
339	NAFB	(3)	116		Operation: Have six different hoses, color coding/marking properly would help in the operation; have seen systems blow up because of wrong hook ups.	X							
341	NAFB	(3)	116		Instructions too complex in tech manual.	X			X				
355	NAFB	(3)	116		Mule leaks only when full and the wrong switch is thrown.	X							
362	LAFB	(3)	116		Mule loses prime causing loss of volume control - volume stabilizes at 30-35 gpm.	X	X						
363	LAFB	(3)	116		Color coding of hoses using shrink tubing failed because shrink tubing wore/ripped away during use.	X			X				
1006	LAFB	(3)	116		Operating check list is worthless	X			X				
1011	LAFB	(3)	116		Compensator valve loses prime frequently		X						
1014	LAFB	(3)	116		Flow meter blew up (lens protected user), supply & return lines were inadvertently swapped - needs to be murphy proofed	X					X		
1156	NAFB	(3)	116		The compensator valve on the newer mules loses its prime and if it is opened too far the needle valve unseats. You then have to take the top off to fix it.	X	X	X					
344	NAFB	3			Typeface worn off labels under knobs and gauges.	X							
1165	NAFB	(3)	344		Can't read knob and gauge placards on some units that are only four years old.	X							
368	LAFB	3			Remove panel on mule so it will run longer before it overheats.	X							X
1009	LAFB	(3)	368		Hot days with 20 min operation unit temp can reach 160¡ F, removal of outer door panel will keep unit cool for awhile longer - alternative is get another mule (time consuming)		X						
1018	LAFB	3			Tune ups are more difficult on R/H side vs L/H (aft looking fwd) due to control panel blocking access			X					
1276	LAFB	(3)	1018		Tune-up procedures are difficult. Can do one side okay but can't get good reading on the other side because the control panel is in the way.			X					
1278	LAFB	3			Cooler lines are different sizes and hard to access near the control panel. Lines aren't marked and require too many wrench sizes.			X					
1388	LAFB	3			Mules - leak constantly & heavy/bulky		X			X			
110	PAFB	2			Gas-powered mules are harder to start due to flooding	X							
345	NAFB	2			No wind tie-downs.						X		
349	NAFB	2			Gauges oscillate, need snubber.	X							

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
351	NAFB	2			Pressure control a problem; would like a digital mule.	X							X
356	MHAFB	2			4000 psi systems have line problems.		X						
364	LAFB	2			Hose return reels would be key time saver - would minimize hose damage and leaks.	X			X				
1277	LAFB	(2)	364		Hose storage could use some improvement. Often get dragged. Always having to repair or replace them.	X		X	X				
366	LAFB	2			Lights inside the enclosure would be big plus.	X			X				
367	LAFB	2			Can't see through plastic covers due to scratches, cloudiness, etc.	X	X						
1008	LAFB	(2)	367		Unreadable gauges	X							
1244	LAFB	2			Flapper valve weight on exhaust (right bank) hit lines on control panel. Need to relocate.			X					
1317	LAFB	2			Cross bleeding is a problem (PC to PC).	X	X						
342	NAFB	1			Knobs get hot.	X							
365	LAFB	0			Hydraulic outputs should be vertical to prevent leaks if a hose or connector breaks.	X			X				
1004	LAFB	0			Exhaust air points down & blows fumes into operator's face. (Heat exchanger)						X		
1329	LAFB	(0)	1004		Unit blows too much hot exhaust.	X					X		
1280	LAFB	0			Time delay system for boost pump is not needed. Should be able to bypass. No other units have it.	X							
103	PAFB			NR	Bead blasting of brake assemblies has been the source of contamination to aircraft hydraulic systems. Bead particles eventually enter the aircraft system, requiring aircraft to be purged			X	X				
106	PAFB			NR	Hydraulic mules often delivered to the flightline without enough hydraulic fluid in them	X			X				
117	PAFB			NR	Problem of different aircraft in composite wing require different sizes of hose fittings. Constantly changing out fittings. Solution may be to use a standard A-N fitting (male on the aircraft side/ female on mule side). Would require wrenches	X			X				X
336	NAFB			NR	High usage piece of equipment.	X							
337	NAFB			NR	Environmental temperature: works best in the heat, cold oil is a problem (below 70 deg F) negates test; an oil heater would help.	X							
338	NAFB			NR	Availability a problem; two full mules available plus three -6's; -6 plugs into the -60, puts out 2500 to 3000 psi) used to check radar system.				X				
340	NAFB			NR	Like the analog pressure gauge to operate.	X							
346	NAFB			NR	Navy F-18 and Air Force F-15 use different mules.								X
348	NAFB			NR	Require upgrade to 4000 psi for the B1 volume flow not adequate.				X				
353	NAFB			NR	Need three systems to do flight controls (however, can fake it with two systems).	X			X				
357	MHAFB			NR	Hoses could be 10 -15 feet longer.	X							
360	LAFB			NR	Hydraulics unit needs longer hoses.	X							
1000	LAFB			NR	Hoses not long enough - need extension adapters for hangar use, difficult to find, thus time consuming	X							
1007	LAFB			NR	Most unavailable piece of AGE	X			X				
1279	LAFB			NR	Unit may be over powered. Could run a generator (has enough room). Could put a 3-system gearbox on it. Could also use some maintenance lighting.			X					X

MK-3 Mule

1020	LAFB	4			Back panel is very heavy & bulky - takes 2 troops to remove			X					
1363	LAFB	2			Reservoir fill is not aligned with the servicing hole. Normally need to use flex funnel.			X					

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370	LAFB	(2)	1363		MK-3 hydraulic mule hard to service.	X		X	X				
1019	LAFB	(2)	1363		Electric cart, filling hydraulic reservoir is very difficult - need a long neck funnel (not standard issue)			X					

Jack

10 Ton Jack

1295	LAFB	3			Jack has reservoir problems. Would like to see them made more like the 15 or 20 ton jack reservoirs.		X						

15 Ton Jack

964	LAFB	5			Relief valves fail often, deficiency reports have been written with no response		X						
1296	LAFB	3			Have difficulty adjusting the jacks. Kits for the ram assembly cost $256 for $29 worth of parts.			X	X				
1297	LAFB	3			Need an improved method for towing all tripod jacks.	X							

20 Ton Jack

14	PAFB	5			Brackets which hold the fulcrum for the jack handle constantly break. Purpose of design was to allow handle to slide out for ease of storage. Better way would be to pin handle in the vertical position when jacking is complete	X	X				X		
16	PAFB	5			Pumping unit and reservoir have a tendency to jump out of their locked position and fall. Poor design of the cam lock.	X					X		
608	PAFB	(5)	16		When unit is in use jack reservoirs fall off .	X	X				X		
1162	NAFB	5			20 ton jack pumps are received from supply with dry rotted seals (leak when installed). There is a six month wait for new pumps. NGC recommends items such as this get worked on a scheduled basis while in supply warehouse to prevent seals, etc. from drying out.		X		X				
15	PAFB	3			No way to tow these jacks. Takes two people to move one jack. Needs a hitch designed for it, plus 90-degree lockable casters to permit towing	X							
18	PAFB	(3)	15		Impossible to tow around. Air Force used to have a towbar for this unit with lockable casters	X							
17	PAFB	3			Have to remove legs of unit for mobility					X			
19	PAFB	3			When units had springs for towability, they made it difficult to jack the aircraft until the springs settled. Went to lighter springs to solve this problem	X							
609	PAFB	2			Jack handle is too hard to use on 20 ton jack.	X							

Jack Manifold

1231	MHAFB	3			Quick disconnect seals leak.		X						

Jacks (General)

963	LAFB	5			Pump/Tank falls off during aircraft jacking, usually held on by safety wire		X						
606	KAFB	3			Jacks are field level repairable and they have developed the universal jack tester. Primary problem is seals.		X	X	X				
962	LAFB	3			Single piston type (dual piston OK), loses hydraulic fluid & has air in system - problem is when jacking jet & it starts sinking, must jack faster		X						
605	KAFB			NR	Kelly considers the only problem to be the users.	X			X				X
607	KAFB			NR	They are buying commercial which proliferates vendors and part numbers. Commercial manuals are given a T/O number and it must be ordered through the item manager.				X			X	
864	KAFB			NR	Commercial buy 3/4 yrs ago and old ones are being replaced on attrition basis - Costing a little more, but savings are in a quality product				X				
866	KAFB			NR	Reliable unit, mostly user error - dropped a C-141	X							

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867	KAFB			NR	No proliferation of jacks, too many types that vary by tonnage, ram extension inches, etc. - However, jacks do have multiple aircraft applications								X
					MLG Tire Dolly for C-130s								
25	PAFB	3			Tires (600 lbs. each) constantly fall off of dolly, as Fido chain is too light. Needs a cargo net strapping system that works	X					X		
611	PAFB	(3)	25		Install larger strap on tire dolly to hold tire.	X			X		X		
24	PAFB	2			Jack handle gets lost, and then can't turn jack valve. Recommend a permanently-installed hand knob on valve like the B-5 maintenance stand	X			X				
610	PAFB	2			Change pressure release handle on tire jack dolly.	X							
					Nose Gear Jack								
20	PAFB	5			Brackets holding the fulcrum for the jack handle constantly breaks. Purpose of design was to allow handle to slide out for ease of storage. Vice Grips on the fulcrum works, but not a solution. Recommend a way to pin the handle in the vertical position	X	X				X		
					One Piece Axle Jack								
21	PAFB	3			This older design is easy to use, but very unreliable. Pumps up to a certain level and then just stops	X	X						
1328	LAFB	3			Losses pressure too quickly. Single pistons are the worst. A-10 double piston jacks work better.	X	X						
					Rhino Axle Jack								
23	PAFB			NR	Three-armed jack with a lifting arm in the center (resembles a bomb lift). A nuisance to use, but very reliable	X	X						
					Tripod Jack								
1334	LAFB	5			Pump and tank assembly fall off while using jack.	X	X						
					Two-Piece Axle Jack								
22	PAFB			NR	Newer design, but very cumbersome to use. Good feature is that the pumping handle is away from the fuselage when jacking	X							
					Universal Jack Tester								
865	KAFB			NR	Universal Jack Tester - tests loading of jacks (recently fielded units)				X				
1107	NAFB			NR	New universal jack tester saves much time and is much more accurate. (Kadena has one in use.)	X			X				
					Lift Truck/Jammer								
					Manually Operated Lift Truck								
1361	LAFB	3			MOLT works okay on a flat surface, otherwise it is a pain. Brits have an electric version.	X							
					MHU-83 Jammer								
1255	LAFB	5			If outriggers are leaking it is difficult to repair due to fittings (ram and fittings are never the same). Should have flex lines vs steel and stronger fittings (not brass...brass shouldn't be used on a system greater than 1000 psi).		X	X	X				
172	PAFB	4			Throttle cables stick and break. Perhaps due to inferior units from Supply. Long run and bad cable routing also suspected. There is a tight bend behind the control panel itself.		X						
1290	LAFB	4			Table has lines that often get caught and rip off (in yaw). Head assembly has way too many 'O' rings.		X	X					
171	PAFB	3			Front tires wear out a lot due to the weight it carries		X		X				

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1074	NAFB	3			MHU-83 has problems with hydraulic lines chafing.		X	X					

MJ-1 Jammer

451	NAFB	7			Bottom cover comes loose and picks up debris like a shovel; fix is to get rid of bottom cover.	X		X					
452	NAFB	7			J1 travel bar always losing bolts used to secure it (uses nut, washer and cotter pin).		X	X					
968	LAFB	(7)	452		Travel bar breaks off - FOD problem		X				X		
1131	MHAFB	(7)	452		The travel bar is missing hardware all the time. The MOLT (MHU-194) design is better.	X	X						
159	PAFB	6			Exhaust system is constantly cracking from the elbow out. The engine is shock-mounted while the exhaust pipe is stationary frame-mounted. Problems caused by too much movement. Plus one mount goes from the engine to the exhaust pipe and constantly breaks		X				X		
160	PAFB	(6)	159		Exhaust system is poorly mounted, which cracks under flexing. Exhaust leaks are not permitted on munitions handling equipment. Flexible tubing was used as a fix but didn't work. Will try rubber mounting the bracket next time		X				X		X
163	PAFB	(6)	159		Exhaust U-bolt mount seems to have a weak weld, even on the ones coming in from Base Supply. Not enough weld penetration and break occurs at the weld. Stronger material needed also. Flex portion also needed beyond U-bolt position		X						
464	PAFB	(6)	159		Jammers MJ-1 exhaust cracks.		X						
969	LAFB	(6)	159		Exhaust brackets, at U bolt, crack constantly - Engine is shock mounted vs exhaust pipe solid frame mounted - Problem caused by too much movement thus vibration		X						
1176	NAFB	(6)	159		Experiences many exhaust cracking problems. The muffler is mounted to the chassis and the rest of the exhaust system vibrates too much.		X						
1367	LAFB	(6)	159		Exhausts crack at U-bolts. Weld them two times, then replace them.		X						
164	PAFB	6			Many engine starting problems in the summer time due to solenoid being located in a high heat area. Many fuses blow. A trial fix worked by remotely mounting an external solenoid next to the battery instead of on the starter. A heat shield would help also	X	X						X
165	PAFB	(6)	164		Using preheat in wintertime causes the solenoid to stick. Then fuses to blow when the master switch is turned	X	X						
447	NAFB	(6)	164		J1: Stray voltage blows fuses, would prefer circuit breakers; also fuse is non-standard; have made such a request but was not authorized because they felt the problem causing the fuses to blow should be fixed;		X	X	X				
448	NAFB	(6)	164		J1 and J4's are hard on fuses (20 amps); blow when they try to start; other recommendation is to have spare fuses available on the vehicle.		X	X	X				
456	KAFB	(6)	164		They continually blow fuses which they contribute to the glow plug circuit.		X	X					
457	LAFB	(6)	164		MJ-1 starter too small for unit.		X						
462	LAFB	(6)	164		MJ1 - burning out starters - need more robust starter.		X						
465	PAFB	(6)	164		Move starter solenoid near battery box away from heat.		X	X	X				
852	KAFB	(6)	164		Blow fuses constantly, engineers think problem is in glow plug circuit (guessing) - Not doing anything about problem, don't believe user, i.e., engineers think user is exaggerating to justify correcting problem		X						
965	LAFB	(6)	164		No start hot days & fuses blow at start		X						
966	LAFB	(6)	164		Diagnosis - starter solenoid, during hot engine starts, doesn't close & thus overloads system causing blown fuses/dead batteries - Test fix (PAFB) was to remotely locate starter solenoid in battery box (away from engine heat) with no further problems		X						
972	LAFB	(6)	164		Electric fuel pumps have been disabled due to large amperage draw (blows fuses)		X						
1175	NAFB	(6)	164		Numerous starting solenoids have gone bad.		X						
1252	LAFB	(6)	164		The 20 amp fuse blows more often in the heat. Would like to see circuit breaker.		X	X					
1253	LAFB	(6)	164		Would like to see the starter solenoid placed externally like on Fords.		X	X					
1254	LAFB	(6)	164		If the electric fuel pump is turned on the 20 amp fuse is likely to blow. Pump is switched on separately.	X	X						

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967	LAFB	6			Hyd table tilts (uncommanded) with significant amount weight - safety problem can catch limbs between structure - investigation reveals AGE maintainers don't put enough weight when testing hyd table		X				X		
1359	LAFB	(6)	967		Some of the jammers have bad tilt controls. With significant weight on the table, can sometimes tilt forward on its own. May hit pylon or people.		X				X		
1258	LAFB	6			If fuel tank is greater than 3/4 full fuel leaks from cap due to slosh.	X					X		
1289	LAFB	6			Float bowl always leaks and is not needed. Screw-on canister would be better.		X	X					
168	PAFB	5			Severe corrosion problems near the water causes electrical problems. Steering wheel must be pulled to access wires underneath the control panel. It should hinge upward to permit troubleshooting access		X	X					X
458	LAFB	(5)	168		Need to put cannon plug on control panel wiring harness for maintenance.			X					
463	LAFB	(5)	168		MJ1 - panel inaccessible - add a hinge (under the steering wheel).			X					
974	LAFB	(5)	168		Control panel is a electrical wiring nightmare - need one cannon plug			X					
1288	LAFB	(5)	168		Control panel items are difficult to access. Wire harness length prevents panel from being opened very far. Could use cannon plug on harness to be able to disconnect it.			X					
169	PAFB	5			A and B models need better table locking system. A bolt on arm assembly is used as a locking devise for the cam adjusting system but cams constantly roll loose. Either index cam to keep bolt secure to prevent camber from rolling or design a new system			X					
170	PAFB	5			Glow plug coil breaks down and the pieces go down in the engine intake, which break the valves. Requires replacement of the engine head. Happens on all diesel equipment		X		X				X
461	LAFB	5			Make master switch and start and stop switch the same. When the stop switch is used the master switch is sometimes left on and the battery is drained.	X		X					
1256	LAFB	(5)	461		User seems to be number one problem (leaving stuff on such as the ignition and fuel pump).	X		X					
850	KAFB	5			Rear tires difficult to procure				X				
1105	NAFB	5			Sidewalls of front tires are showing cracks (to the belt) rendering them unusable. Many of the tires are coming from supply in this fashion. Not sure if they are being kept in the warehouse too long, being stored in too hot of a location, or bad from supplier.		X		X				
1251	LAFB	5			Hydraulic drive belt takes 1.5 hours to access.			X					
1287	LAFB	5			Automatic starter is inaccessible and under powered. Solenoid gets worked too hard, causing arcing. Takes 3 hours to remove the 5 bolts to replace.		X	X					
1370	LAFB	5			Optima batteries in the jammers go dead quickly in the summer (2 months). In the winter they last about six months.		X						
459	LAFB	(5)	1370		Charging systems too small on MJ-1.		X						
971	LAFB	(5)	1370		A lot of batteries go dead during summer - last about 2 months		X						
166	PAFB	4			Throttle cables stick and break. Perhaps due to inferior units from Supply. Long run and bad cable routing also suspected. There is a tight bend behind the control panel itself.		X						
442	NAFB	4			Jammers are the most difficult to load because of ramp clearances on the C141 for example often damages the hydraulic assembly that goes to the table and when it's repaired, it's never located in exactly the same place.			X		X			
161	PAFB	3			Wheel assembly cap screws have a tendency to back off and don't hold up. Happens even when they are cleaned and torqued IAW the TOs. Safety wire is no longer required			X					
162	PAFB	3			Rear tire treads wear out too rapidly. Some say this is user induced and is most common on fighter bases due to tight turns during quick turnaround exercises. Harder rubber compound would help		X		X				X
167	PAFB	3			Steering mount brackets constantly crack. A recurrent problem. Cause or solution is unknown		X						
466	PAFB	(3)	167		MJ-1 steering rod cracks.		X						
443	NAFB	3			Jammer vapor locks in very hot weather.	X	X						
1122	MHAFB	(3)	443		Units tend to vapor lock in hot weather.		X						

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
450	NAFB	3			Difficult to get jammer under the BOM, (141 Trailer) sometimes knock off zerc grease fitting.	X		X					
1123	MHAFB	3			During cold weather operations, up and down motions are good but the unit lurches during smaller adjustments.	X							
1241	MHAFB	3			Hydraulic line problems on jammer table were remedied by using stainless steel vs aluminum. Can always go greater, never less)			X					
1250	LAFB	3			Engine cover hits air and fuel filter causing cracks that must be welded.		X	X					
1257	LAFB	3			Centering mechanisms don't even get serviced anymore.....too many leaks.		X	X					
970	LAFB	(3)	1257		Centering mechanism leaks		X						
1259	LAFB	3			The steel braided hoses that run between the bottom of the engine and the frame chafe through.		X						
1292	LAFB	3			Shifter solenoids don't always work (prevents unit from starting in forward or reverse.	X	X				X		
460	LAFB	(3)	1292		Shifter solenoid needs adjusted constantly.		X	X					
973	LAFB	(3)	1292		Shifter solenoid fails frequently		X						
1291	LAFB	(3)	1292		Micro switch on directional control lever must sometimes be messed with to get unit to start.	X	X						
440	NAFB	2			Foam wears on the pod cup; recommend an inflatable bladder.		X		X				
441	NAFB	2			Pins for locking table are nearly all broken (MJ-1).		X						
1368	LAFB	2			MJ-1B needs a headlight for night operations.	X							
446	NAFB			NR	J-1 arms are not long enough to load 120's with unfueled jet (F-15E).	X			X				
453	KAFB			NR	Have gone to wire braided hose (Mountain Home) to handle chafing.		X	X					
454	KAFB			NR	Hydrostatic pumps are out of production (Eaton and Sundstrand). Sundstrand has agreed to provide wear parts for the next three years; they will try to qualify a new pump.			X	X				
455	KAFB			NR	MJ1's came on-line in 1985 and the MJ3's in 1989. Gasoline units are being scrapped.				X				X
848	KAFB			NR	Production vintage - MJ1A, 1985 & MJ1B, 1989								X
849	KAFB			NR	Replacing gasoline engines with diesel on attrition basis		X						
851	KAFB			NR	Hydrostatic pump, Eaton & Sunstrand stopped production, Sunstrand agreed to support spares, for three years				X				
1126	MHAFB			NR	Would like to see unit burn propane vs diesel.	X			X				
1128	MHAFB			NR	The MJ-1 can't be used on the F-15 for AIM-120 loading if the aircraft is low on fuel (can't reach).	X							

MJ-4 Jammer

176	PAFB	6			Jump starts often blow the fuses. Circuit breakers would be helpful				X				X
173	PAFB	5			Parts becoming hard to obtain due to obsolescence (either the wheel bearing or the race)				X				
174	PAFB	(5)	173		Need something like 10 year guarantee on availability of parts when T.O. doesn't list suitable subs				X				
175	PAFB	5			Batteries often go dead. Charging system is poor. Problems are worse during wintertime.				X				
177	PAFB	4			Hydraulic hoses going to the lift table often get bound or cut and spring hydraulic leaks. Braided stainless steel lines and anti-chafing spiral wrap help to prevent problems.		X						X
1073	NAFB	(4)	177		MJ-4 has problems with hydraulic lines chafing.		X	X					
444	NAFB	3			MJ4's: Table very slow in cold weather on certain adjustments; recommend propane operated.	X							
1124	MHAFB	(3)	444		During cold weather operations, up and down motions are good but the unit lurches during smaller adjustments.	X							
178	PAFB			NR	Availability of jammers becoming critical, often between ECM and Weapons Load personnel. Lack of availability causes people to pull fuses or lock up/hide the jammers		X		X				
179	PAFB			NR	Table of allowance for jammers need adjustment. Will become worse with two additional A-10 units and C-130s needing ECM pods uploaded.				X				X

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
180	PAFB			NR	Forks, bars and table adapters are in short supply. Need a way to lock them on the jammer				X				
1125	MHAFB			NR	Would like to see unit burn propane vs diesel.	X			X				
1127	MHAFB			NR	Would like to see a remote control unit similar to the MJ-40 for the MJ-4 to load GBUs.	X							

MJ-40 Jammer

445	NAFB			NR	MJ40 is B-1 specific and has RCA (remote control) would like the RCA on the MJ4.	X							

Maintenance Stand

B-1 Stand

8	PAFB	4			Newer foot-operated coaster brakes are handy, but the latches fall down on their own. Must be wired up which defeats their purpose.	X					X		
1	PAFB	3			Towing tongue doesn't raise high enough to hook up stand to the bread van. Works okay for the AGE tractors, but crewchiefs must move their own non-powered AGE nowadays	X	X						
2	PAFB	(3)	1		Buddy bar is needed to tow a B-1 stand, but they are hard to find (only 4 on the base).	X							
3	PAFB	(3)	1		The tongue needs to be a little longer. Put a snake bend in it to reach the van's towing hitch	X							
599	PAFB	(3)	1		B-1 stands need longer tongues.	X							
602	PAFB	(3)	1		B-1 stands needs to be repaired or changed for towing.	X			X				
6	PAFB	3			Wheels shimmy when B-1 and B-4 stands are pulled too fast. Needs a better wheel caster	X	X						
7	PAFB	3			Brake locking mechanism must be quick to use . When it is difficult to reach locks between the steps, the brakes are less likely to be used	X					X		
12	PAFB	(3)	7		Locking mechanism is poorly located underneath the stand. Hand could be crushed while locking If hydraulic pump fails. Mount on the side like the B-4 stand	X					X		
600	PAFB	(3)	7		Need some kind of lock that can be used without placing hand inside of stand to release.	X							
9	PAFB	3			Railings are difficult to remove and can damage aircraft or smash user's fingers	X					X		
590	LAFB	(3)	9		Hand rails wear on B1 stand.		X						
1249	LAFB	(3)	9		Hand rail pin areas are getting flimsy and wearing out.		X						
11	PAFB	3			Fuel shop requires stands to have a copper/zinc-coated material to serve as static discharge plate, or at least a grounding reel with connector plugs to fit the acft grounding receptacle. A better grounding reel is needed, as they only last about 6 mo.		X				X		
604	PAFB	3			Move or fix ram lock on B-1 stand.	X							
1247	LAFB	3			Pump handle has too much play in it, causing cuts in the bolt. Needs to be hardened steel.		X						
4	PAFB	2			No red band on ram to caution the user the stand has been extended beyond limits						X		
5	PAFB	(2)	4		Need mechanical stop or warning on B-1 to prevent over extension (safety)						X		
10	PAFB	1			Blindly stepping on stand is unsafe as step rise (height) is not evenly spaced when stand is extended						X		
603	PAFB			NR	Combine engine A frame and B-1 stand for engine change. (for A-10)	X			X				

B-2 Stand

584	MHAFB	4			B2 stands are difficult to position even with four people; this is due to a combination of problems including the casters and tow bar.	X							
596	MHAFB	4			B2 stand can only access F-15 tail from one side.	X							

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
					B-4 Stand								
1246	LAFB	5			B-4 stand rams are not the same and there is no annotation of such in the T.O.s.			X	X				
992	LAFB	(5)	1246		Can't rebuild existing rams due to new vendor				X				
31	PAFB	4			Needs a better wheel caster to permit easier towing	X							
1223	MHAFB	4			The pumps are mounted sideways causing leakage and blown seals. Modified brackets to stand pumps upright.		X	X					
34	PAFB	3			Side rails are hard to remove or install. The problem is they are often found half connected. Make them up-and-down retractable (like child gates), which would be easier than aligning pipe stand to the hole	X					X		
32	PAFB	(3)	34		Make rails easier to remove	X							
30	PAFB	2			Ladder on stand needs to be wider and have a higher reaching ladder railing	X					X		
33	PAFB	1			Make rails impossible to climb on. Use steel mesh to prevent climbing						X		
					B-5 Stand								
28	PAFB	7			Hitch holdup latch doesn't work. Tongue falls on people and causes serious injury. Improper/weak spring mechanism.		X				X		
26	PAFB	4			Newer foot-operated coaster brakes are handy, but the latches fall down on their own. Must be wired up which defeats their purpose.	X					X		
27	PAFB	(4)	26		Teeter totter style brake mechanisms also are poorly designed. The older gravity design which required the user to reach down and flip up the lever was the best	X					X		
29	PAFB	2			User must work on his knees when using pump handle (too low). Hard on shoes, uniforms and knees. Recommend bending handle straight up with a tubing bender to allow user to stand upright while operating jack. Add a grip to the handle	X							
					C-1 Stand								
716	NAFB	7			FOD: maintenance a problem; C1 is small and used most frequently, thus it's biggest problem.		X	X			X		X
993	LAFB	7			Support legs breaking & bolts falling off - FOD problem (see below)						X		
994	LAFB	(7)	993		AGE maintainers have been directed by Branch Chief to install self locking nuts on steps & platform						X		
1323	LAFB	(7)	993		Support legs crack and always require welding. Bolts from steps and cross beams fall out (FOD).		X				X		
996	LAFB	4			Casters wear down quickly		X						
36	PAFB	3			Some C-1s have a little mounting plate to put on a pintle hook, while others don't. Towability is desirable, but must be careful when turning	X							
1365	LAFB	(3)	36		Stand is not towing-friendly. Unit has no towbar and must be transported on a trailer.	X							
995	LAFB	3			Stairs crack easily		X				X		
1248	LAFB	(3)	995		Stand could use different type of bed. Not thick enough.	X	X						
					C-5 Stand								
875	KAFB	2			Tail stand corrosion, C-5 tail stand was not primered by the last lot manufacturer (1990), thus corrosion set in		X						
592	KAFB	(2)	875		Corrosion is a problem with the C5 tail stand		X	X					
					Maintenance Stands (General)								
588	LAFB	7			Loose nuts and bolts on stands cause FOD problems.		X	X			X		
215	PAFB	4			Without a doubt, maintenance stands need better casters. Should be lighter weight and have more efficient and correct welds. Need easier disassembly and breakdown for mobility. Better stackability	X	X						X
591	KAFB	4			Casters remain as problems; replace commercial casters with heavy duty casters (B1, B4, B5, B7).		X	X					

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589	LAFB	(4)	591		Casters are broken and bent.		X	X					
874	KAFB	(4)	591		Caster wearout, went to heavy duty casters on B-1, -4, -5 & -7 stands		X						
1364	LAFB	(4)	591		Casters are unreliable and always wear down. Would like to see rubber wheels.	X	X						
595	MHAFB	4			Purchased a F-15 tail stand commercially; large, problem to move and get in place.	X			X				
998	LAFB	4			Bumper pads wear quickly & rips from grommet - replace with large washers	X	X						
1366	LAFB	(4)	998		Grommets rip out of bumper pads. Replace grommets with large washers. A new bumper pad roll is 2 feet too short to go around B-4 stand.		X	X					
1112	MHAFB	4			There is no good maintenance stand for working on the F-15 tail. The B-2 stand only gets one side. The Fin Pod stand (FP) left over from the F-111s gets both sides but is not authorized and takes several people to move it.	X			X				
1381	PAFB	4			Needs a fork lift or crane just to get the B-1 stand on the loader for deployment. Need something that is lighter weight and breaks down and snaps together					X			
1382	PAFB	4			Stands get damaged when trying to stack them. Needs to be designed for easy stacking with a simple strap down method. (B-4 Stand)					X			
1383	PAFB	4			Stands get damaged when trying to stack them. Needs to be designed for easy stacking with a simple strap down method. (C-1 Stand)					X			
587	LAFB	3			Broken tow bars and structural damage on most stands.	X	X						
601	PAFB	3			Need new kind of foot lock on casters.	X							
1384	LAFB	3			Stands - B-1 (doesn't collapse very low), B-4, & C-1 are contributors to cubing out before weighing out					X			
585	MHAFB			NR	Prefer the newer aluminum maintenance stands, easier to maneuver and locate.	X							X
593	KAFB			NR	Quantities of test stands: B1 - 4500 units, B4 - 2500 units, B5 - 3500 units, B7 - 1800 units.				X				X
594	KAFB			NR	They are studying a collapsible maintenance stand that combines several sizes.	X			X				X
597	MHAFB			NR	New one is good. One person can move it into place. Platform is not height adjustable.	X							
598	MHAFB			NR	The maintenance stand for the pylons can't be used because of it's design.	X							
1240	MHAFB			NR	Would like to see a universal maintenance stand developed that you could add to and subtract from like Legos.	X							X
					Tank Build-Up Stand								
1375	MHAFB	5			Stands take too long to build-up. Should standardize stands along with other tools, etc.				X				
					Universal Stand								
582	NAFB	5			New safety circuit to control forward motion is less reliable and more difficult to troubleshoot than old one; the contact tape is a series circuit and if one goes bad you have to troubleshoot the whole tape; susceptible to water, reducing reliability.		X	X					
1082	NAFB	3			Hydraulic pressure tends to bleed off when stand is in raised position. When stands lowers, it will rest on the aircraft. Ellsworth AFB put a check valve in the circuit to prevent this bleed off	X		X					
583	NAFB	(3)	1082		Has a tendency to drift down while working; solved by installing a valve to stop the bleed. (UM01)?	X		X					

Misc In-Shop Equipment

					Batteries								
492	MHAFB	6			Problem with replacing battery cells; each manufacture has it's own part number, and even though cells are compatible, they are restricted to part numbers by tech orders; can't use a SAF with a Marathon for example.			X	X				
1376	MHAFB	(6)	492		Can't use SAF battery cells with Marathon cells even though they are exactly the same. They are each listed as suitable subs but can't mix vendor types.			X	X				
1379	LAFB	(6)	492		Don't replace Optima gel cells...send whole battery back. Also, don't mix SAF and Marathon cells.			X					

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
217	PAFB	5			Gel cell batteries don't always work as advertised. Cranking power during cold weather is wanting		X						X
493	MHAFB	5			Battery grounding stud is softer than the nut, thus strips stud which is part of a higher assembly.		X	X					
1377	MHAFB	(5)	493		The ground bolts on the battery cases are softer than the attaching nut which causes the bolt to strip. Costs $128 to replace.		X						
216	PAFB			NR	Gel cell batteries made it better for deployment. Don't have to disconnect them anymore. Just put tape over the top of them					X			X
486	NAFB			NR	Conducting tests to determine the best batteries: (problems on the F-16, use Eagle Pitcher, ACME); are evaluating gels and acid fibrous Ni-Cad.				X				X
487	NAFB			NR	Problem with common batteries: Using common batteries means northern units are short on cranking current.				X				X
					Battery Charger								
490	MHAFB	5			Can't get parts (fuses, relays, etc.) for the Christie battery charger.				X				
952	LAFB	(5)	490		Circuit cards unavailable				X				
1193	NAFB	(5)	490		Kristie battery charger models RF80H and RF80HGT are very difficult to get spare parts for. This causes aircraft battery shortages.				X				
1219	MHAFB	(5)	490		Battery charger is inaccurate and is difficult to get parts for. Fuses and relays have been on order for over one year. Have no test equipment to calibrate even though procedures are in T.O. TMDE can cal if necessary.		X		X				
1350	LAFB	(5)	490		Blower fans burn out frequently. Circuit cards are difficult to get and the timers can't be calibrated.		X	X	X				
1106	NAFB	5			Battery charging system is not working properly and the battery warranties may be getting voided as a result (Optima 800 gel cells). (Batteries require trickle charge.) Due to the manner in which much of the equipment is being operated, the batteries are exposed to numerous quick starts and short equipment run times.		X	X	X				X
488	NAFB	(5)	1106		Battery charging system is not charging properly; optima 800's require trickle charge.		X	X	X				
494	PAFB	(5)	1106		Battery chargers - need new ones. Old chargers don't work.		X	X	X				X
491	MHAFB	4			Christie battery charger accuracy is poor.		X	X					
950	LAFB	4			Numerous blower fan failures (burn up)		X						
951	LAFB	4			Automatic charging timers don't work - must monitor constantly		X	X					
					Hose Assembly								
617	MHAFB	3			Rubber particles from cutting hoses spread all over, would like a collector (vacuum) attached to retain the particles.	X			X				
1100	MHAFB	(3)	617		Hose cut-off machine needs something to suck up the pieces. Hose assembly machine and cutoff machine should be one unit.	X							
618	MHAFB			NR	Surprised that the hose cutoff and hose assembly are not the same machine.	X			X				
					HT-400								
1133	MHAFB	2			The heatshrinker/wire repair is a problem...too much for the job.	X							
					Large Part Cleaner								
615	MHAFB	3			Would like a bigger large parts cleaner (jet washer), the 15E large strut cannot be accommodated.	X							X
					Purge Unit								
1348	LAFB	6			Purge units cause freeze-up, especially on new LN carts if you don't remove the pump. Purge units don't remove the moisture from the air. New LN carts take a couple of days to thaw out.	X							

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
		Spin Riveter											
1218	MHAFB	5			Spin riveter is outdated and needs to be updated or replaced. Have been working on making this happen for two years. Easily goes out of adjustment due to hammer pressure.	X							
619	MHAFB	(5)	1218		Out dated, loud, goes out of adjustment very easily.	X	X						
		Tubing Bender											
1113	MHAFB			NR	Had to modify tubing bender to fit onto one pallet. Was 2-3 inches too long.					X			
		Universal Fuel Tank Certifier											
234	PAFB	6			Many problems with the box on top that monitors the probes and quantities. Need a parts breakdown to make a field repair instead of sending it to PMEL.		X		X				X
631	MHAFB	6			WRM tanks: In Desert Storm, a certifier was not provided so they made an adapter kit to transfer fuel from Saudi tanks to the test tank specifically for the F-16's.	X			X				
632	MHAFB	6			Tank cell: Tanks are built on-site from parts. It takes about 12 hours to build 9 370 tanks. Have to put stands together which is time consuming, and would like standardization of tool boxes, instructions, checklists, etc. (nothing is standard)				X				
1045	LAFB	6			Presently, one unit operating & the other down for battery box failure - they are using the down units for cannibalization, because battery box redesign is too expensive & ordered parts have a long lead time	X	X						
233	PAFB	(6)	1045		On order for 3 years. Reliability is poor, but does a good job when it is up. Need a good means to troubleshoot external fuel tanks.		X		X			X	
624	KAFB	(6)	1045		Parts are hard to get and expensive			X	X				
626	MHAFB	(6)	1045		Universal external fuel tanks certifier - they are totally unhappy with it.	X							
627	MHAFB	(6)	1045		Battery box is a problem and they are losing circuit cards due to stray voltages; equipment is useless until repaired. (Fix is going on at Kelly).	X	X	X					
1136	MHAFB	(6)	1045		Worst piece in fuel shop. Battery box problems (Fairchild) have yet to be resolved (circuit cards and stray voltage).	X	X	X					
1356	LAFB	(6)	1045		Can't get parts. Battery box is number one problem.		X		X				
890	KAFB	5			Problem also stems from no troubleshooting procedures in the field				X				
1046	LAFB	5			No schematics available				X				
1137	MHAFB	3			Separate bits and pieces for F-15 and F-16 adapters (used with MC-7) are difficult to keep track of due to space.	X			X				
635	PAFB	2			Design manometer to pressurize C-130 center fuel tank.	X			X				
636	PAFB	2			Better grounding reels for hangar.						X		
622	KAFB			NR	Primarily used for the A10 and was originally developed as the universal unit made by Fairchild Industry. It checks the tank fastness, gauges, etc.	X							
623	KAFB			NR	Source controlled items, Government does not own the drawings.				X				
625	KAFB			NR	Battery box meter (cassette) has been ruggedized to replace the existing meter; and overhaul contract is in existence for the battery box.				X				
628	MHAFB			NR	Made by Fairchild.								X
629	MHAFB			NR	F-15 and F-16 adapter kits are supplied.				X				
630	MHAFB			NR	Requires MC7 high volume/low pressure air to do checks.	X							
633	PAFB			NR	Fuel shop; need a cooler that is explosion proof for working in open fuel cell.	X					X		
634	PAFB			NR	Fuel shop; need new blowers for open fuel cell.	X					X		

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889	KAFB			NR	Approx 17 units have been repaired and sent back to the field								X

Servicing

Gaseous Nitrogen Cart

1204	NAFB	5			The copper tubing and brass fittings on the carts must be purchased at a plumbing store (can't be ordered). Stainless steel tubing (if authorized) could be done in the machine shop.			X	X				X
979	LAFB	4			Shuttle valve seizes due to dust collection from wind storms		X						
980	LAFB	4			Parts unavailable (New cart)				X				
978	LAFB	(4)	980		Some gages unavailable (Old cart)				X				
981	LAFB	4			Hoses bubble/leak after a few days installed - blue hoses (Euro-power) OK		X		X				
231	PAFB	3			Undesirable that all eight bottles can be opened the same time, which equalizes the pressure in all bottles through the manifold.	X			X				

GOX Cart

1344	LAFB	5			Manifold valves strip out easily and are difficult to get.			X	X				
1345	LAFB	3			Gauges are in increments of 100 making it difficult to adjust low pressure.	X							

Liquid Nitrogen Cart

413	LAFB	7			Nitrogen carts are a FOD issue - carts come in with nut on shut-off valve missing and handle just hanging there.			X	X		X		
985	LAFB	(7)	413		Shutoff valve knob nut is always gone (using lock tite) - FOD problem						X		
1354	LAFB	(7)	413		Shutoff valve knobs fall off (FOD). Have been putting Loctite on them.		X	X					
977	LAFB	6			LN2 cart - Purging causes accumulation of water & ice, have to wait 2 days for thawing - Also, have to remove pumps to drain water - Purging unit may be culprit (Zwick-83)		X	X					
229	PAFB	5			Need more user friendly Liquid Nitrogen Cart. Too many controls for the user, especially for the beginner.	X							
383	NAFB	(5)	229		Operation: instructions are confusing; rewriting/simplification would help; instructions fail to differentiate between on-line and maintenance shop; knobs/switches are not well located, some are on the side and some are inside.	X			X				
386	NAFB	(5)	229		Operability: two knobs are for operation, the rest for maintenance; 90% of the problems are due to using the wrong knobs; recommend a lockout system or relocation of valves.	X							
391	NAFB	(5)	229		Older carts are somewhat complicated, newer ones are easier to operate.	X							
393	NAFB	(5)	229		Would like instructions simplified.	X			X				
396	NAFB	(5)	229		Nitrogen carts are the most difficult to operate.	X							
397	NAFB	(5)	229		There are a number of valves underneath, all but one (V20) are for maintenance; sometimes misused in operations.	X							
409	LAFB	(5)	229		Too many knobs on nitrogen cart. Won't build up to 3000 psi below 30oF.	X							
412	LAFB	(5)	229		Biggest problem with AGE is operator training, primarily with nitrogen cart. Direction and instruction panel have faded and you can't read them.	X			X				
975	LAFB	(5)	229		Lack of Training - 50% of servicing cart problems are due to user error				X				
982	LAFB	(5)	229		Difficult to operate, 12-15 knobs	X							
1198	NAFB	(5)	229		Test/repair knobs are being turned and adjusted by flightline techs. Consider some type of digital interface with lock-out code to prevent this.	X		X					X
1343	LAFB	(5)	229		Lack of training is the biggest problem...most problems are operator induced.	X			X				
1195	NAFB	5			Wait time for pumps is in excess of three months.			X	X				
395	NAFB	4			Electric N2 carts have an availability problem due to reliability and parts availability.		X		X				

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1220	MHAFB	(4)	395		Carts are too old and are hard to get parts for. B-1 valve is no longer manufactured. Item managers need a heads up/warning to seek a second source.				X				
410	LAFB	4			N2 cart shuttle valve gets caked-up with dust.			X					
1341	LAFB	(4)	410		Shuttle valves seize up on the older carts due to.dirt. Have trouble getting parts for the newer carts (4-6 weeks for a pump).		X		X				
411	LAFB	4			N2 cart high pressure hoses bubble and gets cuts and gashes. Happens year around so not temperature related. Replacement (blue) hoses are better but are in short supply.		X		X				
1342	LAFB	(4)	411		Hoses go bad quickly (get bubbles). New hoses (blue ones) are better but are difficult to get.		X			X			
1194	NAFB	4			Pressure valves (PR9) diaphragm tears particularly in the summer. Also, bypass valves wear out quickly.		X		X				
230	PAFB	3			Build-up took 35-40 minutes while depleting only 50 percent of the nitrogen. Works too slow	X							
382	NAFB	(3)	230		Availability: one of the longest wait items.				X				
408	LAFB	(3)	230		N2 cart slow to build up.	X							
983	LAFB	(3)	230		Wait long periods of time for pressure to buildup 3000 PSI - During cold weather below 30¡ F, 3000 PSI is unobtainable	X							
984	LAFB	(3)	230		Takes along time to buildup pressure for only a couple of servicings								
1351	LAFB	(3)	230		Some of the older carts take forever to build up adequate pressure.	X							
1353	LAFB	(3)	230		The newer carts have poor capacity. Only get a couple of uses out of it depending how much pressure is needed and how long it sits.	X							
380	NAFB	3			Operability: difficult to use at night.	X							
381	NAFB	3			Hard to turn and manually move.	X							
384	NAFB	3			Nitrogen carts vary in performance; newer one (Libbey) is user friendly regarding repair and is reliable. Older ones are unreliable, have heat sensitive parts.		X	X					
387	NAFB	3			Gauge faces deteriorate in the sun but can't be replaced separately, must replace the whole gauge.	X		X	X				
400	NAFB	(3)	387		Glass is part of the gauge and can't be replaced; glass parts not available.			X	X				
976	LAFB	(3)	387		Cart lenses can't order individually (must order gage)				X				
1199	NAFB	(3)	387		Gauge faces (soft plastic lens) have a tendency to cloud. When this occurs you have to replace the entire gauge or take a lens from a new gauge. The lens is replaceable but you can't order it separately.	X	X	X	X				
394	NAFB	3			Instruction plates are unreadable.	X							
1200	NAFB	(3)	394		Operating placards tend to weather over time and can't be read. These must be manufactured locally in order to replace them.	X		X	X				
388	NAFB	2			Maintenance: Steel plumbing is available through normal supply channels, copper plumbing is available only through local shops (considered a deployment issue).			X	X	X			
385	NAFB	(2)	388		Parts available quickly using a local P/N. Take much longer with NSN.				X				
389	NAFB			NR	Prefer the older technology self generating into carts so called recommend it's use on MASS.								X
390	NAFB			NR	Purity: Still in controversy one school says 95% the other 99% (the latter apparently because that's what they get in the bottles). Osmosis can provide up to 99% but takes much longer and are more expensive.				X				X
392	NAFB			NR	Osmosis system is available but large and expensive.				X				X
398	NAFB			NR	5 year plan calls for a replacement nitrogen cart and the Air Force is on the street for an osmosis system. They have received four carts, none of which are acceptable; will go on street again with a more definitive specification.				X				X
399	NAFB			NR	Two different styles of old nitrogen carts are available, LN2 and Bottles.				X				X
401	KAFB			NR	Signus is replacing the nitrogen carts and 6 months ago went on the street with an RFP. They received four bid samples, none of which met the requirements. The quality of the response was very poor, partly due to the fact the RFP was general.				X				X

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
402	KAFB			NR	They are redefining the requirements and will be coming out with a new RFP. Controversy is the purity requirements (99.5% at the upper end, reflecting the F-16 bottle system and 95% for the remaining systems). Mem Sys takes 75 min to produce.				X				X
403	KAFB			NR	There are only three membrane manufacturers in the U.S.; costs are roughly $10K per membrane (one membrane equals 10 SCFM)				X				X
404	KAFB			NR	Some membrane carts are automatic, others have to manually monitor the membrane temperature	X			X				X
405	KAFB			NR	At 10 SCFM it takes 2 hours and 15 minutes to fill the tanks. The new requirement has increased the rate to 15 SCFM				X				X
406	KAFB			NR	They are looking at purchasing some bottle carts.								X
407	KAFB			NR	On a new RFP, they are asking for an operating panel and a maintenance panel separately.	X		X	X				
871	KAFB			NR	New procurement - Self Generating Nitrogen Servicing Cart (SGNSC) will replace LN2 carts								X
872	KAFB			NR	RFP process is going very slow due to commercial procurement and requirements are too general thus vendors not meeting them								X
873	KAFB			NR	Controversy is the purity of nitrogen, i.e., technology does not produce levels specified by aircraft in the inventory, 95.5% as opposed to 99.5%								X
		LOX Cart											
379	NAFB	6			New ones come up so fast they can expend blow out disk.	X	X						
991	LAFB	6			LOX cart - Purging causes accumulation of water & ice, have to wait 2 days for thawing - Also, have to remove pumps to drain water - Purging unit may be culprit (Zwick-83)		X	X					
377	MHAFB	4			Are old, spare parts are a problem, waiting for self-generating carts as replacements.		X	X					
1221	MHAFB	(4)	377		Carts are too old and are hard to get parts for.				X				
990	LAFB	4			Manifold valve fails frequently		X						
1079	NAFB	4			Can not replace the front wheel bearing by itself. T.O. 37C-8-25-4 has no breakdown of the hub. It lists the hub as the next higher assembly.			X	X				
232	PAFB	3			Sometimes the nozzle won't lock on securely when servicing LOX bottles and leaks within the cart itself	X	X						
376	MHAFB	3			Moisture is a problem, lox sometimes freeze bottles open.	X		X					
988	LAFB	(3)	376		Servicing nozzle freezes up frequently	X	X						
378	NAFB	3			Old carts took forever to build up pressure.	X							X
1201	NAFB	(3)	378		Old LOX cart is very slow to build-up. Newer carts build-up fast and may rupture the blow out disc.	X					X		
986	LAFB	3			Should have 50 gals fully serviced, always get cart with 35 gals (opening pressure relief valve drops quantity)	X	X						
987	LAFB	(3)	986		Inadequate capacity - Maintainers say don't drop below 15 gals therefore 20 gals usable	X	X						
1332	LAFB	(3)	986		Cart drops from 50 gallons to 35 gallons when vent valve is opened. Valve must be opened unless servicing or transporting.	X	X		X				
1333	LAFB	(3)	986		Feel capacity is inadequate. Can't use if below 15 gallons.	X							
989	LAFB	2			Pressure gage calibration, i.e., sending to PMEL is a hindrance - alternative would be, install a known calibrated gage, check reading, reinstall existing gage; if reading is same good-to-go				X				
1349	LAFB	(2)	989		Pressure gauge must be sent to PMEL for cal every 12 months. Should be able to cal right on the cart. Also, T.O. calls for cleaning the gauge inside and out with Trichloride-based compound that will soon be prohibited.			X	X				
1346	LAFB	2			If cart is emptied it must be purged (no positive pressure).			X					
375	MHAFB			NR	Hoses could be 10 -15 feet longer.	X							

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
					Oil Cart								
43	PAFB	6			Contaminates the aircraft due to rain. Needs a cover to protect it			X	X				
					Special Purpose Flightline								
					Cabin Leakage Tester								
47	PAFB	7			When the unit is turned off, the unit always catches fire at the exhaust area (diesel engine). No matter what base or location, these units all exhibit the same exact discrepancies of catching on fire and erratic pressure control	X	X				X		
49	PAFB	(7)	47		Base has an electric unit, a gas unit and a diesel unit. Gas unit has outlived its life. Catches fire				X				
511	LAFB	(7)	47		Need to close exhaust cover to extinguish backfire on cabin pressure cart (I think).	X							
513	PAFB	(7)	47		Unit sometimes catches on fire: NSN 4920-00-43-9397 Cabin Tester.	X	X	X			X		
1037	LAFB	(7)	47		Several fires in exhaust area due to backfiring/post ignition, finally have to pull choke to shut it down & close exhaust door (Old models)		X				X		
1347	LAFB	(7)	47		Older units sometimes catch on fire when shutdown (post ignition). Must choke it out. Newer units (with key) seem to work okay.		X				X		
1163	NAFB	7			These are comments on a new CLT just received from Hydraulics International: Unit is not fully painted. There is no tech data for the unit. Can't use it or order parts against it because it is not in the system yet. Most latches were riveted and were loose. Operating instructions were put on with tape labels...need to be painted. Has good engine (Hatz?).	X			X			X	
45	PAFB	6			Unit is supposed to pressurize the aircraft slowly, but at idle it often jumps to high pressure immediately	X	X						
46	PAFB	(6)	45		Unit is supposed to depressurize the aircraft slowly, but it often drops the pressure immediately with the possibility of damaging the cabin pressure regulator on the aircraft	X	X				X		
500	NAFB	(6)	45		Leak testers tend to leak themselves.	X	X						
1038	LAFB	(6)	45		Sporadic relief valve failures (New Gas model)		X						
48	PAFB	4			Has the old Packard engine. Ready for a new engine, although old one still works. Parts are hard to get. The new unit is a good one (diesel)	X			X				X
1039	LAFB	4			Random rate of climb altimeter gage failures		X						
1040	LAFB	4			Random governor failures		X						
1041	LAFB	4			Canopy seal regulator - 2 failures in past year (Electric)		X						
44	PAFB	3			Hard to start and often requires a new battery or a jump start	X	X						
497	NAFB	(3)	44		Hard to start.	X							
512	PAFB	(3)	44		Cabin pressure tester too hard to start.	X							
498	NAFB	3			Sight glass window deteriorates.	X	X						
1035	LAFB	(3)	498		CLT gage can't read due to glazed lens		X						
501	NAFB	3			CLT-2 made by Hydraulics International; equipment comes improperly cabled, needs standoffs to prevent chafing.			X	X				
1167	NAFB	(3)	501		Hoses are improperly clamped to the engine causing chafing, etc.		X	X					
504	NAFB	3			Some delivered with key start instead of a start button (lose the key and lose the unit).	X			X				
505	NAFB	3			Filter located behind throttle lever which must be removed to change filter (appears that the designer flipped the throttle lever upside down to reverse the cable run).			X					
1168	NAFB	3			Fuel gauges are inaccurate. One unit in particular indicates 3/4 when the tank is full.		X						
503	NAFB	2			No wind tie downs on operating panel door.	X			X		X		
1169	NAFB	(2)	503		Control panel door opens then folds in half. Door bangs unit and can flop in the breeze or jet blast. No way to secure it.	X					X		

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
1166	NAFB	2			Filters are too expensive (Hatz). There are cheaper substitutes such as Fram.			X	X				
502	NAFB	1			Throttle missing limit stop.	X							
499	NAFB			NR	Needs an external temperature gauge along with the internal one (some are heat issues).	X							
506	KAFB			NR	Fixture to test the tester: Contractor has one but the Air Force doesn't. They want it as part of the accessory equipment, it is included in T/O but not ready for field, the price is unknown.				X				
507	KAFB			NR	Current unit is diesel powered, replacing a gasoline engine driven unit which is no longer supportable. This unit is improved regarding gauges etc.		X		X				
508	KAFB			NR	The cabin tester is purchased as a spec item, thus several models exist.				X				X
509	KAFB			NR	One unit is peculiar to the B1, the rest satisfy multiple aircraft.				X				X
510	KAFB			NR	Problems with water getting in and shorting, their concerns that this may cause a fire. 440 volt system that has been rewired to 220 volts.		X	X					X
854	KAFB			NR	Existing CLTs - (250) AF/32T-1 Engine - (60) AF/M24T-3 Electric								X
855	KAFB			NR	Replacing gas engines with diesel on attrition bases (designated F model)		X						
856	KAFB			NR	SA-ALC states they need a test fixture for the CLT, i.e., need to test the tester - can not test unit when it is going out to the field				X				
1036	LAFB			NR	Must shutdown all other maintenance operation during test - safety precaution	X	X						

H-70 Hydrazine Response Trailer

244	PAFB			NR	Each F-16 unit must come up with their own hydrazine response mobility trailer. A standardized unit can be ordered, but it is way too expensive.				X				X

Test Set

AFCTS (Auto Flight Control Test Set)

542	NAFB	3			Problems with boxes, adapters and cables.	X	X						
543	MHAFB	1			Don't have a laptop diagnostic system yet for flight control test set, would like one.			X	X				X

AGM-65 Test Set

1212	NAFB	5			The AGM-65 guided missile test set (AN/DSM 157) has numerous power supply problems. Suspect that possibly the Hobart and -60 generator output surges and blows the CRT. Also, the power is too noisy to permit the unit to pass self-test.	X	X						
559	NAFB	(5)	1212		AN/DSM157: Numerous power supply problems (attributed to using a generator and blowing out CRT's with power surges)(OAFI self test for AGM-65).		X		X				

AIS

1337	LAFB	6			Many of the cables are way too large (128 pin). Should be broken up into 2 or 3 cables. Can't get removal tool to work properly.			X					
1087	MHAFB	4			Older test stations have poor reliability. Getting parts for them is also a problem. Many come without the necessary attaching hardware.		X		X				
1088	MHAFB			NR	The F-16 test stations housed in the mobile shelters must be removed and staged separately for deployment. This equals approximately 2 or 3 pallets worth of equipment. Would like to be able to leave the stations in the mobile stations (bolted down) for transporting.					X			

ALM 191 Radar Rcvr Test Station

130	PAFB	4			Low reliability. Possess three, but only one is operational. Parts shortage due to obsolescence		X		X				

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
		APU Tester/A-10											
203	PAFB			NR	Unit is disliked by A-10 crewchiefs	X							X
		Armament Test Set (169)											
1095	MHAFB	2			Test set gets its power from the aircraft. Have cables all over the place when in use.	X					X		
		Borescope Test Set											
1187	NAFB	2			If test set is not adequately cooled down the light burns out and costs $485 to replace.	X	X						
		Cable Fab											
621	MHAFB	2			Heat shrinker is too much equivalent for short job and is never used.	X							X
620	MHAFB			NR	Braiding machine is good.	X							X
		Carbon Seal Tester (CST)											
516	NAFB	6			Can't get them replaced because of extensive paperwork/justification (6 documents, one for each); condemmable only at depot level.				X			X	
734	LAFB	5			Vacuum tester is needed - have two but they are junk. (PWA 5009 or 5009)	X							X
515	NAFB	4			Low reliability; problem to repair (supposed to be field repairable, but problematic).		X	X					
517	NAFB	(4)	515		1976 vintage; historically difficult to troubleshoot; replace extra parts because of diagnostics issues.			X	X				
1182	NAFB	4			Vacuum/pressure cart is experiencing repair parts obsolescence. Basis of issue (BOI) is too low.	X		X	X			X	
518	NAFB	3			Operation problematic; may take an hour to get the required flow.	X							
1186	NAFB	(3)	518		Vacuum tester (flow) is very difficult to use.	X							X
519	NAFB	3			Difficult to use; large and hard to maneuver; new version is suitcase size and is OK.	X							X
958	LAFB	3			Cumbersome to maneuver	X							
514	NAFB			NR	Ultimately to be replaced (current one made by Garrett).				X				X
520	MHAFB			NR	The old tester is considered junk (cumbersome and unreliable), the new one is great.	X	X						X
		Chaff/Flare Tester (APM-427)											
1338	LAFB	3			Most of the time the tester lights operate properly but the counter does not.		X						
		CSBPC Test Set											
1211	NAFB	4			The F-15 Control Stick Boost Pitch Computer (CSBPC) part numbers 68D300020-1007 (E/F) and -1001 (C/D) have no current supply source for its multi-layer circuit cards. Nellis was able to obtain one card from a source that is not a McAir subcontractor.			X	X			X	
		CSFDR											
548	NAFB	3			It is the most time consuming system on the aircraft (takes 45 min/jet; everything combined takes 2 hours/jet	X							
550	NAFB	3			Many different interfaces								X
		Data Link Test Set											
1210	NAFB	5			The data link test set for the F-15 (GJM-59) has serious problems passing self test.	X	X						
554	NAFB	(5)	1210		GJM-59 Data link test set; problems getting it to pass the self test	X	X						

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					DDU for TEMS								
202	PAFB	3			DDUs for A-10s are big and heavy, and the internal Nicad batteries don't hold a charge. Would prefer a laptop computer like the ones used at Davis Monthan AFB.	X	X						X
					ECM Program Loader Verifier								
123	PAFB	4			Had to locally manufacture cable groups due to inability to procure them (ALE 47)				X			X	
					ECS Tester								
1043	LAFB	7			Plastic protective caps, on removal user leave them laying around, need lanyard to hold caps - FOD problem	X					X		
1352	LAFB	3			The ECS tester has too many pieces. Takes forever to inventory (approximately 30 pieces) the tester.	X			X				
1042	LAFB	(3)	1352		Takes along time to inventory, 30 pieces - maintenance delays	X							
					Engine Vibration Analyzer								
201	PAFB	4			Meters often don't work and won't calibrate. PMEL often sidelines the units for parts		X		X				
					EUs								
956	LAFB	6			DI test station, cable is very large & difficult to repair	X		X					
957	LAFB	4			GPS antenna EU has L/H threads (coaxial cable) - user has striped threads several times			X					
					F-16 Testers								
561	NAFB	5			ANAPM427 Radar Simulator test set: Three classified cards consolidated into one, erasable from outside; problem - no T/O reference to prove it is unclassified resulting in thousands being destroyed since it could not be reclassified				X				
558	NAFB	4			TS4044: Problem blowing up cards when plugged in with the new cards; problem didn't exist with the older cards			X	X				
700	NAFB	4			F-16 download computer cables aren't rugged - bend and break; push button controls are breaking.		X						X
539	MHAFB	3			T169 tester on flight line: Works on right side not on left (inverted).	X	X						
540	MHAFB	3			T169 works intermittently, is worse in cold weather.	X	X						
556	NAFB	3			16U75500-855; not well designed for maintenance; certain circuit cards do not have extenders; about three different kinds of boards				X				
538	MHAFB	(3)	556		855 for F-16 tester can't self-test; T170 self-test cables.	X							
552	NAFB			NR	AE24T-169 Weapons test set (air/air, air/ground)								X
553	NAFB			NR	AE24T-170 Missile Launcher and pylon test set								X
555	NAFB			NR	68D30020-1007 or -1001; control stick boost pitch compensator								X
557	NAFB			NR	IR Simulator, AIM-9 test set								X
					Fire Control Test Set								
1209	NAFB	3			Fire control test set experiences numerous IR fails		X						
551	NAFB	(3)	1209		AE24T-198 Fire control test set IR fails		X						
					Flight Systems Testers								
537	MHAFB			NR	The only value in modification of the testers is in miniaturization; suggestion combines various radio test sets into one.				X				X
541	MHAFB			NR	LATS tester: Only have one and when deployed there is none on base.				X				

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					Frequency Converter								
482	NAFB			NR	Much preferred over the motor generator; significant improvement in R&M.		X	X					X
					Gun Fire Test Set								
1380	LAFB	6			If ground is lost on the P-1 fire head, user gets severely shocked. The wire is on the outside (piggy backed) and tends to break a lot.		X				X		
771	MHAFB	(6)	1380		F-16 tester has a ground in back of P1. If it breaks and power is applied, it will knock a person off the aircraft.	X					X		X
					IFF Transponder								
961	LAFB			NR	Not enough units - 3 or 4 units for six squadrons				X				
					ILS Test Set								
127	PAFB	2			Batteries run down too quickly (C-130 comment)		X		X				X
					JFS/CGB Test Stand								
1097	MHAFB	4			This test stand is in serious need of modernization. It is comprised of 1960's technology and you must scrounge for parts. The tech data could also be more clear. Test stand is used daily.	X	X	X	X				
1185	NAFB	3			JFS fuel atomizer test set - fuel clouds the glass. Digital readout would be preferred depending upon what is being read.	X							X
613	MHAFB			NR	Used daily to test jet fuel starters.	X							X
1184	NAFB			NR	JFS/CGB test set is supposed to be used with a crane/hoist. Units only weigh 70 pounds...crane is a waste of time.	X							X
					K400 Generator Test Stand								
1111	MHAFB	4			Can't get adapters to run CSDs and generators. Could fix approximately 50 percent of what is sent off station if permitted. Would save $6K per generator and $12K per CSD.	X			X				
485	MHAFB	(4)	1111		K400 test generator test stand was used for the F111; feel they can repair 50% of the generators sent to depot but they are not authorized to test it. They have a F111 generator test stand available with spline adapters to use on F-15s and F-16s.			X	X				X
496	KAFB	(4)	1111		Luke has the capability to test generators. Mountain Home has the requirement and capability, but not the hardware to test generators.				X				X
857	KAFB	(4)	1111		Test stand (tests IDG as a unit), can't get adapters to run different units, thus troubleshooting is non existent				X				
858	KAFB	(4)	1111		Must send complete IDG unit to depot (CSD-OK city & GEN-SM-ALC) - $6K/unit				X				
483	NAFB			NR	Can apply resistive and reactive loads on generator; provides CRT/computer readout.	X							X
484	NAFB			NR	No problems reported.								X
495	KAFB			NR	Generator test stand: Oklahoma is prime for the constant speed drive, Sacramento is prime for the generator. The old MC2 test stand was belt driven.								X
					Lantirn Test Set								
1206	NAFB	3			LANTIRN test set self test does not take into account wiring problems. Wiring problems do exist.	X		X					
					Memory Load Verifier (668)/MLV/PLV								
545	NAFB	6			Won't work at all in the sun/summer heat. (PLV)	X	X						
1021	LAFB	6			Raymond cartridge - high failure item, being worked by Avionics Working Group		X						
1335	LAFB	(6)	1021		Cables were found to be wrong. Raymond cartridges have a high failure rate.		X						

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1022	LAFB	6			During rain can't reprogram jet. (MLV)	X							
544	NAFB	4			Memory loader and verifier: circuit cards fail regularly (upgrade from block 40 to block 50 may have resolved the issues).	X	X						
546	MHAFB	3			It is faster to pull the unit and send to the back shop than to use the portable memory loader/verifier on the aircraft.	X			X				
547	MHAFB	3			Takes 1/2 to 2 hours to load/verify.	X							
1083	MHAFB	3			Would like to see lap top computers to replace the MLVs. At present, GAK load could take 10 minutes. Can do same load with backshop equipment in four minutes.	X							X
1096	MHAFB	3			PLV sometimes takes 1.5 to 2.0 hours to load. Would like to see faster, easier to load lap top size computers.	X							
Mets Test Set													
1207	NAFB	5			There are no schematics available for the METS test set. (McAir)			X	X			X	
702	NAFB	4			METS: Laptop troubleshooting aids; missing schematic to complete troubleshoot.			X	X				X
Multimeter/Fluke													
1023	LAFB	3			During hot weather meter reads erroneous. (Simpson)		X						
1340	LAFB	(3)	1023		Meters are often inaccurate in the heat. (Simpson)		X						
1134	MHAFB	2			Meters tend to freeze up below 32 degrees.	X							
Phase Angle Volt Meter													
125	PAFB	5			Unit is made by North Atlantic and is old. Unit too sensitive when someone else is jamming a pod, running radar on the side or keying a radio microphone. Goes out of alignment. Used for boresighting Pave Penny pod. Digital unit is forthcoming	X							X
Propeller Synchrophaser Test Set													
128	PAFB	5			Tech order is very poorly written and hard to use. Calls out switch positions that do not exist.	X			X				
575	PAFB	(5)	128		Prop sync test set; instructions are confusing and not user friendly.	X			X				X
PS-6 Fuel Quantity Test Set													
126	PAFB	5			Problems with the battery in it. Too sensitive and touchy. Must play/jiggle with switches	X	X						
Signal Processor Test Sets													
129	PAFB	4			Low reliability. Five possessed, but only two are operational. W/R is the depot		X		X				
Stray Volts Tester													
124	PAFB	3			C-130 squadrons need stray voltage testers, vice Fluke meters. Each C-130 has 18 flare dispensers, with 30 pins per dispenser. Checked pin per pin, with each pin checked twice. Check could be reduced from 30 to 10 minutes, with one person, vice two				X				X
122	PAFB			NR	Availability/fielding problem of the Smart Breach Plate Adapter for the ALE 40 chaff/flare system. USM 262A Test Set is on the TA but not fielded. Used for the stray volts system test for the chaff/flare system.				X			X	X

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
					Transponder Test Set								
1213	NAFB	4			transponder test set (AN/APM 424V2) (all aircraft) has a high failure rate. Suspect design flaw that can't be isolated at PMEL. Largest problem is with repeat switch (item manager is aware of problem). During cal of this unit, it must be totally disassembled to gain access to one test point even though there are spare pins available on plug that can go to the breakout box. (A suggestion has been submitted.) Breakout box is also made by Teledyne.		X	X	X				
560	NAFB	(4)	1213		AMAPM424V2 Transponder test set: During calibration, must completely disassembly to get to the test point; there are spare pins on the cannon plug that they believe could be used; same problem on three different units; fix is a T/O to make the mod			X	X				
					TTU-205								
1093	MHAFB	3			Biggest problem with the TTU-205 is the adapters leaking. If they are good, the only other problem is that it takes too long to run up.	X	X						
1044	LAFB	(3)	1093		Pitot static tester takes approx 1 hour to run test	X		X					
					Tools								
					CTK								
1215	NAFB			NR	Nellis AFB has a tool tracking system which utilizes bar code technology. The tool room monitors approximately 1200 transitions daily and has coded roughly 900 tools and 1500 T.O.s. This system eliminates chits and reduces FOD.							X	X
					Engine Tools/Misc.								
1183	NAFB	6			-229 engine tooling is too flimsy. Safety hazard. (disk and hub/turbine shaft nut) Tool slips...can cause damage to shaft.	X	X				X		X
572	NAFB	5			508 gauge (hydraulic torque wrench) wobbles and can't be rigged properly.	X							
1179	NAFB	5			Hydraulic cart (PW 5096) pump motors go out - actuates variable vanes on engine.	X	X	X					
573	NAFB	4			Engine Diagnostic Unit (EDU) located on the engine: Connectors MEDU hard to get to (located in the rear); the test cell hook-up is OK.	X							
567	NAFB	3			-229 tooling is complex, too many pieces, and somewhat difficult to use (hard to hook up and the aluminum spacer doesn't fit properly)	X			X				
571	NAFB	3			-220 fan module holding tool designed for a stripped fan; dressed fan has interferences; 229 fan module holding tool is OK.	X		X					
574	NAFB	3			Heater control box: Temperature not reading on the box, can overheat part if not careful; used on all three engines. (Heats turbines when pressing them on the shaft.)	X							
1178	NAFB	3			Inlet fan module fixture (220 engine) has stripped teeth (PW 2646-2647)	X	X	X					
566	NAFB	2			Hub puller (-220, -229, and -100) three sets of tooling, one for each engine; would like commonality				X				X
568	NAFB	2			General: In many cases have newer better tools, but have to replace one at a time; Would prefer item manager to replace all at once when a new tool comes out, would save paperwork and aggravation.				X			X	X
1180	NAFB	(2)	568		Tooling requirements for engine build/teardown should be handled like TCTOs (auto replaced - don't have to order). Too much bureaucracy to order new tooling. Item manager should handle TA authorizations.							X	X
569	NAFB			NR	P & W Tooling: Have regular interface between P & W and user community; suggest talk to P & W people.				X				X
570	NAFB			NR	CGB & JFS hoisting a problem (unit only weighs about 70 lbs., but requires a crane that takes 15-20 minutes to hook up because of special attachments required).				X				

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
1102	NAFB			NR	Nellis AFB has a tool tracking system which utilizes bar code technology. The tool room monitors approximately 1200 transitions daily and has coded roughly 900 tools and 1500 T.O.s. This system eliminates chits and reduces FOD.							X	X
1339	LAFB			NR	There is a myriad of useless engine tools.	X			X				

Tow Vehicle/Truck

Coleman/PSI

525	MHAFB	5			Psi's are considered disasters, have very low reliability.		X						
1054	LAFB	5			Frequent shift problems (can't shift into drive) occur with failures of shifter & steering selector switches		X						
1053	LAFB	3			Chevy diesel hard starting and just quits frequently		X						
1055	LAFB	3			Door latch doesn't latch properly, need to slam door thus shattering window - have gone to plexiglas on attrition basis (dubbed suicide doors)		X				X		
200	PAFB	2			Latches on the windows and the stiffeners hinder driver visibility. Older Colemans were much better	X					X		
198	PAFB	1			There is a 3-position selector handle to permit wheel crabbing and rear wheel steering. The rear wheel steering function has been deleted, which is very useful for positioning an aircraft in a hangar. Permits tighter turns in tight spots	X							
199	PAFB	1			Steering wheel continues to turn after the point of wheel lock. Consequently, the steering wheel spokes will no longer be in the same position as before when the vehicle was traveling in a straight line. Wheel provides no reference point for the driver	X							

Eagle (85/86Ls) (Bobtail)

1052	LAFB	6			Two engine fires due to battery cables		X				X		
1049	LAFB	5			Either steering or brakes out, had to use emergency brake several time - replaced type of master cylinder, with small improvement		X				X		
530	LAFB	(5)	1049		Bobtail has brakes and steering problems. You either have steering or brakes.	X	X						
1324	LAFB	(5)	1049		Unit seems to have either brakes or steering...never both. New master cylinder has helped some of the braking problems. Transmission shifts too hard (whiplash)	X	X						
1050	LAFB	5			Transmission jumps when it shifts, troops bang their heads against windshield & jet lunges (dubbed the whiplash mobile)		X				X		
529	LAFB	3			Bobtail door latches are broken and door will not stay shut.		X						
1325	LAFB	3			May be an over-voltage problem...lights are always burnt out.		X						
528	LAFB	(3)	1325		Bobtail unit lights burn out too fast.		X						
1051	LAFB	(3)	1325		Head lights burn out frequently, possible over voltage		X						
523	NAFB			NR	Bobtails break more frequently.		X						

Tow Tractors

522	NAFB	5			Problem areas are brakes, transmission, leaks.		X						
521	NAFB			NR	Break frequently, are old.		X						
524	NAFB			NR	Want Eagles because of steering.	X							
526	MHAFB			NR	MD4's do not have reliability problem.		X						X
527	MHAFB			NR	Stewart Stevens are better but cannot tow heavy aircraft.	X	X						

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
					Utility Vehicle								
218	PAFB			NR	AGE maintainers want to maintain their own vehicle, in lieu of the motorpool. Their vehicle gets redlined too much			X					X
					Towbar								
					CFT Dolly Towbar								
534	NAFB	5			Both side are almost identical, except one cost $192 the other side $800 (the one that brakes).				X				
1158	NAFB	5			CFT dolly towbars for the F-15 always break directly behind the support. Can weld and brace the break (with a sleeve) and it will break again farther down. The side that pivots is normally the one that experiences damage. Suspect this may be caused by trying to turn it too sharply with the Bobtail.	X	X						
533	NAFB	(5)	1158		Have problems with one side breaking.		X						
887	KAFB	(5)	1158		Field problem - R/H turn bends bar, fix by welding patch to beef up area - engineer stated, either wrong tow vehicle is being used or it is the old tow bar design, new bars should not have this problem	X							
					Universal Towbar								
197	PAFB	6			Sometimes the crank handle for the adjustment of the towbar wheels breaks off, which takes the entire towbar out of service		X						
195	PAFB	4			A-10s use the shorter ones. The small pins that engage the nose wheel will break off.		X						
536	MHAFB	4			Prefer strap hold down in lieu of spring; manual latches wear out quickly.		X						X
196	PAFB	2			The mechanism to adjust the bars are sometimes difficult to move	X							
888	KAFB	2			Largest repair problem is elongation of the bar after time		X						
531	NAFB			NR	Is the biggest delay.				X				X
532	NAFB			NR	Like universal tow bar.				X				X
535	MHAFB			NR	F-15 and F-16 use the all purpose (universal) tow bar.	X			X				
					Trailer/Dolly								
					3000 Engine Trailer								
1056	LAFB	4			Double handled - can't tow 4000 trailer therefore must transfer to 3000 trailer	X							
					4000 Engine Trailer								
776	MHAFB	5			4000 engine trailers: Spare parts discontinued, made by McDonnell Douglas, Superior welder, etc. with different T/O's for each. Hydraulic valve durability and cylinders durability is lacking (cheap).		X		X				
1098	MHAFB	(5)	776		Trailer has problems with cylinders/valves and hand pumps. Needs to be modified/upgraded. Tech data could also be more uniform. Have approximately 12 T.O.s saying basically the same thing (one for each manufacturer).		X		X				
1177	NAFB	4			4008 engine trailer has leaky seals (mainly on the frame lift)	X	X	X					
1057	LAFB	2			Cradle adjustment difficult to turn	X							
					A Frame for C-130 Engine Change								
253	PAFB	4			Need design change to permit dropping engine with the prop installed. Much easier to remove engine/prop as an integral unit, reduces damage potential on flightline, plus would save 1 to 2 hours R&R time	X		X	X				

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
A-10 External Fuel Tank Stand													
235	PAFB	4			Required for separation of the nose and tail of the external 600 gal A-10 fuel tank for maintenance. Unit permits precise alignment for tank reassembly. Stand is too large for inside storage and too difficult and complex to operate	X				X			
A-10 Tank Loader													
236	PAFB	5			These 600 gal tanks are modified F-111 tanks, thus the dolly/loader is long and hard to maneuver. As a result, the turn stops on the tie rods are frequently broken. This takes the dolly out of service immediately	X	X						
240	PAFB	(5)	236		Turn radius is too large. Needs an acre to turn it around. Suffers broken tie rod bolts when trying to turn too tight.	X	X						
237	PAFB	4			Hydraulic lines from the hand pumps will burst due to wear or tank weight when removing them from the aircraft. Tank has no access door to permit use of a defuel hose. Nose down attitude of tanks permits 100 lbs. of fuel to remain after defueling by air		X						
238	PAFB	3			The tables for fore and aft/left and right tank movement sometimes don't work	X	X						
239	PAFB	3			The spring-loaded handles on the wheel controls are sometimes missing, which makes tank alignment tedious	X			X				
Engine Change Beam/A-10													
204	PAFB			NR	Was originally designed to also hook up to the aft engine cowl to roller it back out of the way. Is easier to just take the cowl off the manually. Therefore the beam could be cut and shortened by perhaps 30 to 40% to permit loading on an engine trailer	X				X			
F-16 Centerline Tank Dolly													
241	PAFB	5			They are a mess. Parts are hard to get. Lift cylinders freeze. They are bad news. Other bases always rebuild them. Same pump as on B-4 and B-5 stands, and it leaks all the time, due to its sidewise mounting. Pump needs to be mounted horizontally.		X						X
1145	MHAFB	5			F-16 tank dolly must have cargo straps on frame to prevent it from spreading. This is considered an ancient design. Unable to modify it to fix it. Start over.	X	X						
954	LAFB	(5)	1145		Legs separate and have dropped several tanks - troops have wrenched a cargo straps together	X					X		
1222	MHAFB	5			Boat jack with steel bearing wheel (approx $400) can be made for approximately $30. The boat jack concept is considered inadequate and is in the way.	X			X				
783	MHAFB	(5)	1222		Tank dolly uses a boat jack in front and it is not strong enough; it is also regularly damaged in towing because it's not sufficiently retracted.	X	X						
Fuel Tank Dolly													
784	MHAFB	6			Tank dolly is so bad the feeling is it should be redesigned from scratch.	X	X	X	X				
953	LAFB	6			Double handling of tanks - 3 to 4 troops needed to load tank on screw jack dolly (several injuries have occurred at this point),dolly to jet	X			X				
781	MHAFB	5			Tank dollies: 200 pounds empty, designed for light weight (say 600 lbs.). They can be loaded considerably higher with fuel in and the frame will collapse.	X							
787	PAFB	(5)	781		Tank dollies are large and hard to use, but can not hold the weight if the tank is full. A wing tank will hold 600 gallons. 600 X 6.5 = 3900lbs.	X							
1144	MHAFB	(5)	781		Weight capacities are inadequate due to fuel in tanks. Reservoir is built into frame. If frame or reservoir cracks, must disassemble entire frame.	X	X	X					
1142	MHAFB	4			Casters on tank dollies are unreliable in the winter. Replaced some with B-4 stand casters. Towing speeds (10 mph max) are inadequate. Vibration locks brakes...need to consider rough surfaces during design. Need to over-design these type things. Smallest tire should be the size on the NF-2.		X						
1143	MHAFB	3			Need to simplify the braking system (not like -85).	X		X					

ID:	Loc:	SevFac:	Ref:		Problem/Deficiency:	Usab	Rel	Main	Supt	Depl	Saft	Ad	Com
788	PAFB			NR	No drain on tank to drain fuel when fuel will not transfer to aircraft.	X							

MHU-141 Trailer

449	NAFB	3			M-10 chocks need to be higher to install the wings and pins on the A-9; old M9 chocks were OK.	X							
1058	LAFB	(3)	449		M10 chocks (xmas tree type) very difficult to maneuver around when installing AIM-9s - could be a accident waiting to happen (LAFB just received M10 chocks)	X					X		
1374	MHAFB	(3)	449		If the chocks were slightly higher on the MHU-141 trailer the larger diameter munitions could be removed without damaging the service fitting on the jammer.	X							

Trailers (General)

778	MHAFB	5			Not designed for rugged environment such as Saudi or Egypt which have dirt roads.	X			X	X			
779	MHAFB	(5)	778		Tires on some units are too small, smallest should be 580 X 8's.	X			X	X			
782	MHAFB	5			Internal reservoirs (built into the frame) are bad because the frame must be replaced when it cracks.			X					
775	KAFB			NR	There is a high rate of updates on T/O's. The T/O's are general in nature and much is left to the reader.	X		X	X				
777	MHAFB			NR	Tow speeds on flight line are unrealistically low (callout 10 mph).	X					X		
780	MHAFB			NR	Recommend use of tire clamps instead of regular brakes because of brake problems.	X							X
785	MHAFB			NR	Don't want self-propelled units (maintainer view is that it is more hardware to maintain).	X		X					
786	MHAFB			NR	50% of the maintenance requirements are associated with abuse and operator error, partly because they are pushed for time.	X		X					

Technologies With High Payoff Potential
(Top 25% Scores)

212 Liquid Flow-Through Cooling for Power Supplies

Synopsis: Boeing is using liquid flow-through cooling in power supplies for the common integrated processors (CIPs) in the USAF's F-22. The module converts 270 VDC electrical power to 5 VDC. Each module has an output up to 400 W, and can operate in parallel with up to nine other modules, for a total output of 4,000 W. Polyalphaolefin liquid coolant flows through narrow channels in the module to cool these power supplies. The modules are designed to be line-replaceable within 15 minutes. Quick disconnect fittings are provided for the coolant lines. The design gives a mean time between failure of 25,000 hours, and increases the maximum output of each module from 250 W to 400 W, according to Boeing. A module is 6.4 x 5.9 x 0.6 inches and weighs 1.8 lbs. Boeing recently delivered the first flightworthy power supplies to Hughes Aircraft, who builds the CIPs.

Source: Aviation Week & Space Technology, 26 Feb 1996, pg. 41.

Potential Apps: The technology concept of a liquid cooled avionics suite has the potential to reduce the requirement for certain pieces of flightline support equipment, such as -10 air conditioners. Although considered state of the art, the F-22 avionics suite required a new piece of ground support equipment to be introduced (called the PAO cart) to circulate the polyalphaolefin coolant during ground maintenance. As this technology matures over the next few years (as well as electronics that emit less heat), on-board, flow-through liquid cooling will totally eliminate the requirement for ground-based air conditioners.

Air Conditioner	**Score:**	**276**	**Risk/Cost:**	**90-95**
Deployment	**Score:**	**6**	**Risk/Cost:**	**90-95**
		282		

247 High Temperature Electronics (Up to 535 Deg C)

Synopsis: Transistors capable of operating at temperatures of up to at least 535 deg C have been developed by Astralux Inc., of Boulder, Colo. The high temperature electronics, to be available by year-end, will allow aerospace designers to eliminate heavy and bulk cooling systems and place electronic control systems closer to heat sources. Conventional silicon transistors will not function above 150 deg C. The new transistor uses gallium nitride and silicon carbide materials to achieve its high temperature performance, according to Jacques Pankove, Astralux vice president of research and development.

Source: Aviation Week & Space Technology, 8 Apr 1996, pg. 13.

Potential Apps: The S-class electronic components developed for the US space programs over the past 20 years have boosted avionics reliability to unprecedented levels. Unfortunately, gallium arsenide and other exotic compounds for space electronic systems come with a very high price tag, which has precluded them from aircraft application. Silicon carbide materials may not be in this price category, and could, therefore, be the "Holy Grail" long sought by electronic engineers. The high heat tolerance of 535 C for transistors would liberate on-board electronics of ancillary ground power cooling, particularly if the electronics were integrated with a liquid loop cooling system for stabilization. This technology has a high payoff potential in the areas of system reliability, SE reduction, SE deployability and supportability.

Air Conditioner	**Score:**	**276**	**Risk/Cost:**	**90-95**
Deployment	**Score:**	**6**	**Risk/Cost:**	**90-95**
		282		

279 High Performance Heat-Absorbing Material for Liquids or Solid Materials

Synopsis: A new thermal management technology is being tested that can increase thermal storage up to 10-fold in solids and up to 40-times in liquids. Known as microencapsulated phase change materials, the micron-sized particles have the potential to significantly reduce aircraft weight, cost and life cycle expense, according to Frisby Technologies, Inc., a Freeport, N.Y., company that is commercializing the technology. MicroPCMs consist of a heat-absorbing core within a durable shell wall. They can be used in a slurry in recirculating cooling systems, work passively in powder form or be used as an additive in composite materials, foam insulation, and coatings.

Source: Aviation Week & Space Technology, 27 Mar 1995, pg. 15.

Potential Apps: The technology concept of a liquid cooled avionics suite has the potential to reduce the requirement for certain pieces of flightline support equipment, such as -10 air conditioners. Although considered state of the art by eliminating the C-10 air conditioner, the F-22 avionics suite required a new piece of ground support equipment to be introduced (called the PAO cart) to circulate the polyalphaolefin coolant during ground maintenance. As this technology matures over the next few years (as well as electronics that emit less heat), on-board, flow-through liquid cooling will totally eliminate the requirement for ground-based air conditioners. The incorporation of MicroPCMs into the polyalphaolefin coolant on board the aircraft may have the potential to eliminate the need for POA carts for the F-22 and JSF aircraft.

Air Conditioner	**Score:**	**276**	**Risk/Cost:**	**90-95**

Deployment **Score: 6** **Risk/Cost: 90-95**

282

282 Whisper Power Ground Power Unit From Hobart

Synopsis: The Hobart Whisper Power can produce 120KVA to meet the ground power needs of modern transport aircraft. The Cummins 200-hp engine that powers the unit can be started with the push of a button. A starter lock-out helps prevent flywheel damage. An in-line fuel pump helps reduce emissions from the engine, which burns Jet A fuel. The Whisper Power features pivot-point steering, which improves maneuverability in congested ramp areas. The unit's drum brakes are designed for long life, and meet US military requirements. Features of the unit's integrated control box include color-coded, numbered wiring, adjustable components, circuit breakers instead of fuses, inside lighting to ease maintenance and a weather-resistant enclosure. In addition, all wiring is condensed into four plugs, to allow a quick-disconnect capability. Switches, meters and fault indicators are arranged on a Lexan-covered control panel. The Whisper Power's storage area provides space for stowing cables when the ground power unit is not in use. Hobart Ground Power, 1177 Trade Road E., Troy, Ohio 45373-2975.

Source: Aviation Week & Space Technology, 13 Mar 1995, pg. 114.

Potential Apps: The ground power unit is arguably the most frequently used piece of powered AGE on the flightline. Due in part to the high frequency of use, the -60 and -86 generator units garnered more problem areas and deficiencies during the SEEIT field visits than any other type of equipment. The basic technology level of these units are decades old, and incorporate precious few of the modern power control and management devices found on today's commercial power units. The Hobart Whisper Power unit is considered by some as the new unit of choice when it comes to stable power source with low maintenance requirements. The flightline complaints against the two current generator units include: 1) power and frequency fluctuations, 2) difficult to position, 3) units too heavy, 4) hard to read frequency and voltage meters, 5) aircraft rejects power unit, 6) unit smokes, 7) ineffective kill switch, and 8) engine wet stacks. With the critical demands of commercial aviation, it is difficult to imagine their tolerance of problems of this nature.

Ground Power/Start Cart **Score: 276** **Risk/Cost: 10-15**

360 Immersion Phase-Change Cooling for Aircraft

Synopsis: Purdue University researchers are experimenting with a new liquid immersion cooling technique to meet the heat dissipation needs of future high density avionics and supercomputers. Phase-change cooling has already demonstrated the ability to dissipate over 600W of heat from a single half-inch square chip, and may absorb over 2,000W per module in the future. The new Air Force F-22 and the Army RAH-66 Comanche will require 200-300W cooling. The phase-change technique's advantage results from the coolant on the surface of the avionic device boiling as it absorbs heat from direct contact, and changing from a liquid to a vapor. Phase-change cooling will give more than an order of magnitude improvement over passive air cooling and three times the cooling of immersion in liquid without phase-change. The research project is using Fluorinert FC-72, a dielectric coolant made by 3M. In operation, the coolant would be pressurized to 22 psi which causes the bubbles to condense rapidly as they leave the surface of the device. The bubbles work as powerful micro-pumps.

Source: Aviation Week & Space Technology, 7 June 1993, pg. 146.

Potential Apps: There is still a technology need for better heat dissipation techniques for present day and future high density avionics suites. The concept of a liquid-cooled avionics suite for the F-22 was thought to have the potential to reduce the requirement for certain pieces of flightline support equipment, such as -10 air conditioners. Although considered state of the art by eliminating the C-10 air conditioner, the F-22 avionics suite now requires a new piece of ground support equipment to be introduced (called the PAO cart) to circulate the polyalphaolefin coolant during ground maintenance. The search for the "Holy Grail" of heat dissipation techniques long sought by electronic engineers plods onward. Phase-change cooling using a dielectric coolant on board the aircraft may have the potential to eliminate the need for POA carts for the F-22 and JSF aircraft. This technology has a high payoff potential in the areas of system reliability, SE reduction, SE deployability and supportability.

Air Conditioner **Score: 276** **Risk/Cost: 90-95**
Deployment **Score: 6** **Risk/Cost: 90-95**

282

297 RAZ and miniRAZ Munitions Handling Trolleys

Synopsis: The "RAZ" and "miniRAZ" munitions handling trolleys were developed by Electra Mikun in accordance with Israeli Air Force requirements, based on operational and combat-proven experience. Special emphasis was placed on achieving significant time reductions in all stages of equipment handling, culminating in shorter aircraft turnaround times. The trolleys consist of two major subsystems: the handling system and the cradle, which can be separated from each other. A wide variety of load configurations can be handled to include TER loads from 10.5 inches diameter up to 16.5 inches diameter, such as MK-82s, MK-83s, AGM-65s on LAU 117s, triple Mavericks on LAU 88s, etc.

Source: Composite Wing Future Requirements Study, Northrop Corp, Aug 93, pp. 15-16.

Potential Apps: The " RAZ" and "miniRAZ" munitions handling trolleys are a combat proven design, simple, reliable, and easily maintained. They can handle nearly every type and combination of munition/dispenser with high efficiency at low cost. The pitch and lift system is simple to control, as it has an 85 percent efficiency under full load. Preloads can be prepared and stored on the cradle with no double handling required. The unit is

easy to maneuver, position and operate, as many safety and human engineering features have been incorporated into the design. These units are available now and are an excellent mobility item. Additionally, the "RAZ" and "miniRAZ" are ideally suited for long-term storage until needed.

Lift Truck/Jammer	**Score:**	**252**	**Risk/Cost:**	**0-5**
General SE	**Score:**	**40**	**Risk/Cost:**	**0-5**
		292		

356 Multiple Integrated Power Unit (MIPU) For Aircraft

Synopsis: The multiple integrated power unit (MIPU) is a single, on-board source of air and electrical power suitable for normal and self-sufficient dispersed operations. In the air-breathing mode, the MIPU provides ground power for systems checkout, ECS air, emergency power, main engine ground start, and inflight start to 20,000 feet. While in the gas generator mode, it provides emergency power and main engine restart above 20,000 feet. MIPU technology should reduce aircraft (secondary power system) weight, enhance survivability, and improve reliability. Cost implications of this technology are considered to be moderate.

Source: ATF Technology Insertion Requirements, circa 1989.

Potential Apps: The MIPU serves the combined functions of an on-board APU and EPU with the extended ground operation capability of a generator unit. As a single unit, the MIPU requires fewer mechanical couplings, drives and gearboxes onboard the aircraft. Sufficient on-board power and air conditioning permits 20 to 30 minutes of BIT checking and troubleshooting without ground power and air conditioning units. Although a similar concept was proposed for both the YF-22 and YF-23 fighter designs, a PAO ground cart was ultimately required to provide liquid coolant to the F-22 avionics suite. When avionics suites are developed that have better heat tolerance, the on-board MIPU will enable the aircraft to be completely free of both ground power and air conditioning units.

Ground Power/Start Cart	**Score:**	**220**	**Risk/Cost:**	**65-70**
Air Conditioner	**Score:**	**190**	**Risk/Cost:**	**65-70**
Deployment	**Score:**	**12**	**Risk/Cost:**	**65-70**
		422		

298 Hepp Vapor Engine for a Family of Multifunction Support Equipment

Synopsis: A novel prime mover is under proprietary development at joseph hepp engineering, Canoga Park, Ca., involving the use of superheated steam as the working fluid for a modern vapor engine. Combining modern materials, electronic engine controls and staged combustion with flue gas recirculation, the Hepp vapor engine provides numerous advantages over the typical internal combustion engine used in today's support equipment. Unlike internal combustion engines, torque output for a vapor engine remains constant over a wide rpm band. It also produces significantly lower emissions due to very high combustion efficiency. The principles in use today in stationary furnaces, such as staged combustion and flue gas recirculation, provide a means for regulating the combustion temperature without reducing efficiency, thereby carrying combustion to completion. Emissions as low as 5 ppm VOC, 10.5 ppm CO and 9 ppm NOx have been demonstrated. This compares to 150 ppm VOC, 2,000 ppm CO and 36 ppm Nox currently allowed by SCAQMD Rule 1110.2. An electronic igniter, similar to a standard furnace ignitor, will provide rapid firing, with warm-up time occurring in less than one minute at subzero temperatures. The vapor engine can burn JP-8, JP-5, JP-4, Jet A, DF-2 or gasoline interchangeably. When integrated as an engine-driven alternator, the vapor engine will produce very clean power with rapid response to load changes and a capacity for transient overloads. A variable speed, constant frequency alternator is also well suited to the power characteristics of a vapor engine, which can respond briefly to overload conditions. Electric power increases linearly with speed at constant current: vapor power increases linearly with speed at constant torque. A diesel engine cannot easily match these conditions, but a vapor engine is well suited to any electrical power generation technology. As an external combustion engine, other options exist when using separate components. The steam generator can supply many other engines, or the steam can be bleed from the primary engine to provide auxiliary power in various forms. Auxiliary expanders using bleed steam are simple and very lightweight for the power produced, with exceptional reliability and low maintenance. No losses arise from conversion from one commodity to another (shaft to electricity back to shaft), so efficiency remains high. If auxiliary requirements are high, a separate high pressure boiler can be added to achieve maximum flexibility. But if auxiliary power demand is a fraction of the primary engine demand, steam can be bled from the primary engine to drive the auxiliary functions. This steam is at lower pressure, temperature and density, making it easier to distribute and utilize. Fractional horsepower requirements for auxiliary equipment may be conveniently met with electric motors, providing simplicity, low maintenance and ease of control. Where higher horsepower requirements exist, a steam engine or turbine provides a low-cost, low-weight power source, with incremental power-to-weight ratio exceeding a gas turbine engine. Maintenance is lower and reliability is higher than a diesel engine. Both steam engines and steam turbines produce a high starting torque, providing simple control, such as opening a steam control valve to start an auxiliary drive.

Source: joseph hepp engineering, 22323 Lanark Street, Canoga Park, CA 91304.

Potential Apps: The vapor engine has many maintainability, durability and O&S cost saving advantages over gasoline, diesel and gas turbine engines. Preventive maintenance is nearly nonexistent, as no engine coolant or lubrication systems are required. Components of a conventional ignition system, such as distributors, sparkplugs, voltage coils, and ignition modules are also eliminated, as a standard electronic pilot light is used for ignition. Other components not needed include starter motors, gear reduction boxes, torque converters or clutch assemblies. A simple electrical system is used to power the fuel pump, the electronic control system, a forced draft blower and the solenoid valves for fuel flow and water flow. If requirements dictate, the engine can be designed to completely eliminate the electrical system, but from an ease of control standpoint, an electrical system is very convenient. Even considering the dimensions of the flash

boiler, the vapor engine achieves significant weight savings by eliminating much of the dumb iron. During subzero operations, the boiler is protected with a simple antifreeze or alcohol solution. It will start readily in less than one minute in any weather. The vapor engine is highly adaptable as the prime mover for multifunction SE, as it can deliver multi-point shaft power for pumps, compressors, and generator/alternators without gear reductions. It also has a unique auxiliary power capability similar to compressor bleed air, suitable for engine starting and also heating and cooling demand using small, low weight components. Its low weight approaches that of a gas turbine engine with fuel economy comparable to a diesel engine. In an enclosed hardened shelter during combat operations, the low noise and efficient combustion of a vapor engine would permit extended maintenance operations with much less noise fatigue or polluted breathing air for the maintainers and aircrew. The modularity options offered by the vapor engine for multifunction support equipment (including a lower unit profile and stackability of the units) make it an ideal mobility enhancer due to its a designed-for-deployment features, lighter weight and compact footprint.

Ground Power/Start Cart	**Score:**	**218**	**Risk/Cost:**	**90-05**
Hydraulic Equipment	**Score:**	**209**	**Risk/Cost:**	**90-95**
Auxiliary Lighting	**Score:**	**171**	**Risk/Cost:**	**0-5**
Air Compressor	**Score:**	**168**	**Risk/Cost:**	**90-95**
Air Conditioner	**Score:**	**159**	**Risk/Cost:**	**90-95**
General SE	**Score:**	**106**	**Risk/Cost:**	**90-95**
Deployment	**Score:**	**30**	**Risk/Cost:**	**90-95**
Servicing	**Score:**	**10**	**Risk/Cost:**	**90-95**
		1071		

1 Multifunction Aircraft Ground Support System (MAGSS)

Synopsis: The Multifunction Aircraft Ground Support System (MAGSS) concept (multiple SE functions contained in a single unit) offers excellent potential for significant airlift savings for both near and long terms. If one or more functions of the proposed design don't satisfy all Composite Wing aircraft requirements, the modularized functions could be removed or re-engineered to meet the shortfall in requirements.

Source: Lear Astronics Corporation/Developmental Sciences Center, 1930 South Vineyard Avenue, Ontario California 91761. Phone (909) 947-7600 and Facsimile (909) 947-1823.

Potential Apps: MAGSS offers 7 functions in support of aircraft in a flightline environment. It uses a single multi-fuel engine, is self-propelled, utilizes commercial off-the-shelf line replaceable units, and is designed to operate in extreme weather and CBR environments. It provides variable pressure (0-250 PSIG) compressed air, variable pressure (50-4500) nitrogen, 60 KVA 400 Hz AC electrical power, 350 AMP DC power, Pneumatic air of 150 pounds per minute (S.L. 59oF day), 4000 PSIG hydraulic with a flow rate of one system at 30 GPM or dual systems at 15 GPM, and environmental cooling of 85 pounds per minute (40oF to 200oF). Four lights can be attached, one at each corner, to provide lighting for night maintenance operations. The MAGSS unit weighs 6500 pounds dry and has a volume of 377 cubic feet.

Ground Power/Start Cart	**Score:**	**211**	**Risk/Cost:**	**15-20**
Hydraulic Equipment	**Score:**	**209**	**Risk/Cost:**	**25-30**
Auxiliary Lighting	**Score:**	**171**	**Risk/Cost:**	**0-5**
Air Compressor	**Score:**	**160**	**Risk/Cost:**	**20-25**
Air Conditioner	**Score:**	**151**	**Risk/Cost:**	**0-5**
General SE	**Score:**	**108**	**Risk/Cost:**	**20-25**
Deployment	**Score:**	**30**	**Risk/Cost:**	**20-25**
Servicing	**Score:**	**24**	**Risk/Cost:**	**0-5**
		1064		

40 Rare-Earth Magnet Direct Drive Servovalves (DDV), Electrically Controlled

Synopsis: In the early 1980s, the aerospace fluid power industry started development of DDVs for use in actuation systems that are powered by high-pressure (5,000-8,000 psi) hydraulic systems. Since then, DDVs have been a focus technology within the industry. These valves were made possible by the development of rare-earth magnets that allow sufficient forces for electrical current to drive an actuator's main control valve without hydraulic amplification. The DDVs have several advantages over conventional servovalves for actuation systems that require redundant hydraulic and electronic and electronic inputs. The major advantages of an activation system designed for a DDV over a conventional servovalve design are: reduced hydromechanical complexity, higher reliability, less hydraulic power consumption, simplified fault monitoring concept, and, in most cases, smaller packaging requirements. Currently, DDVs are being used for flight controls in several tactical aircraft which are in development or production: B-2, F-15E, F-15SMTD, F/A-18E/F, F-22, FS-X, JAS-39, YF-22, YF-23 and X-31. DDVs were also used in engine controls for the Pratt & Whitney YF119 engines in the YF-22 and YF-23 aircraft. DDV aerospace technology is also being transitioned to commercial and industrial applications. The examples included submarine controls, control of animatronic figures, tensile and fatigue test equipment, factory automation, automotive applications such as active suspension and power steering, and in-well geophysical seismic sources.

Source: Aerospace Engineering, Apr 1996, pg. 39.

Potential Apps: This technology is known under a variety of names. However, the main impact is that the central hydraulic system is eliminated for the aircraft. As such, there would be no requirement for hydraulic test stands. Hydraulic mules are one of the most troublesome pieces of support equipment out on the flightline. Generally, the basis of issue for hydraulic mules for a squadron of fighter aircraft is two, each of which weighs nearly 7,000 lbs with a volume of 474 cu. ft. The elimination of this piece of SE would be of major significance to deployability, reliability and supportability.

Lift Truck/Jammer	**Score:**	**197**	**Risk/Cost**	**25-30**
Cargo Handling	**Score:**	**154**	**Risk/Cost:**	**25-30**
		351		

152 Electrohydrostatic Actuation (EHA) System for Primary Flight Controls

Synopsis: Flight testing is underway on an advanced control surface actuator installed in an F/A-18 systems research aircraft at NASA's Dryden Flight Research Center. The electro-hydrostatic actuator (EHA) is the second of three advanced actuators to be tested as part of the Electrically Powered Actuation Design (EPAD) validation program. The actuator and electronic controller operate the left aileron without the use of aircraft hydraulics. The device, activated by the flight control computer, uses electrical power generated by the aircraft's engines to drive a pump that has a small quantity of internal hydraulic fluid. Program officials said use of such electrically powered devices in place of traditional hydraulic systems has the potential of achieving significant savings in aircraft weight, cost, complexity and maintenance requirements. They also could make aircraft less vulnerable to ground fire. The EPAD project has been managed by USAF's Wright Laboratories, with participation from contractors including Lockheed Martin, Vickers ElectroMech, Dynamic Controls and Dowty Aerospace. Dryden provided ground testing, installed the device and is conducting the flight test program.

Source: Aviation Week & Space Technology, 12 Feb 1996, pg. 42.

Potential Apps: EHA systems have the potential to eliminate centralized hydraulic systems (pumps, fittings, tubing, and large reservoirs) and provide significant benefits that are of particular interest in aircraft and ground power system design. EHA benefits include improvements in vulnerability resistance, power consumption, maintainability, and reliability. These benefits are easiest to attain in large, existing transport-type aircraft and in new aircraft designs because of their impact on aircraft subsystems and structural design. Additional features that are difficult to implement in pure electromechanical actuation systems are jam resistant, overload protection, backdriving/bypass functions, damping, fretting/wear and gear ration. At a system level, the EHA system is generally lighter in weight than comparable hydraulic systems. The Mechanical Systems Technology (MST) Technology Application Program Management (TAPM) office at the Oklahoma City Air Logistics Center (OC-ALC) recently installed the EHA on the left aileron of the High Technology Test Bed (HTTB) C-130 aircraft. Two successful test flights were flown with additional flight testing planned. Future applications for the EHA may include operational C-130 aircraft.

Lift Truck/Jammer	**Score:**	**197**	**Risk/Cost:**	**25-30**
Cargo Handling	**Score:**	**154**	**Risk/Cost:**	**25-30**
		351		

309 Electric Vehicles

Synopsis: Based in Indianapolis, Indiana, Electricore's participants from 17 states seek to help U.S. automakers reach the critical mass needed to successfully introduce electric vehicles in the region where many of these vehicles may first be built. Electricore is closely allied with industry participants which include the recently announced AC Delco Systems merger of Delco Remy and AC Rochester to focus on EV/hybrid vehicle technology and alternative fuels. In addition, General Motors has formed Delco Propulsion Systems, based in Indianapolis, consisting of AC Delco Systems, Allison Transmission and Delco Electronics to coordinate the development of components and propulsion systems and offer sales and marketing of EV batteries, motors and related systems. Electricore is committed to rapidly developing and deploying electric vehicle technology and products both at home and abroad. It seeks to create thousands of jobs in mid-America, significantly improve the environment through the reduction of toxic emissions and, as EVs become a major part of the American transportation system, reduce the nation's dependence on foreign oil. Electricore plans to deploy 15 mid-size electric powered pickup trucks and electric and hybrid electric buses. Seven trucks will be field tested at both the Naval Surface Warfare Center, Crane Division in Indiana and at the Tank Automotive Command base in Michigan. The hybrid electric powered shuttle buses will be evaluated in real life, real-time testing situations in Indianapolis, Indiana and Chattanooga, Tennessee.

Source: Internet, 1996 Electricore Consortium, Ellen G. Engleman, Executive Director, 723 West Michigan Street, SL-164, Indianapolis, IN 46202, (317) 278-1667, E-mail: engleman@aol.com

Potential Apps: Electric vehicle technologies could be applied to cars, trucks, or busses. In the support equipment environment, this technology could be applied to tow vehicles, jammers, or similarly propelled vehicles.

Lift Truck/Jammer	**Score:**	**195**	**Risk/Cost:**	**40-45**
Tow Vehicle/Truck	**Score:**	**46**	**Risk/Cost:**	**40-45**
Environmental	**Score:**	**7**	**Risk/Cost:**	**40-45**

Deployment	**Score: 6**	**Risk/Cost: 40-45**	
	254		

176 Modular Aircraft Staging System - Maintenance Stands

Synopsis: The Modular Aircraft Staging System is designed to give aircraft maintenance crews the quick deployment capability and other features of custom-designed work platforms at lower cost. In addition to straightwork platforms, stairway, nose dock, over and under-wing bridges and tail dock modules are available. The modules can be used alone or linked. Their height can be adjusted by up to 3 feet. Two people can easily move the modules, which feature a 1,323-lb capacity, 42-inch-high heavy aluminum guardrails, 12-inch-diameter casters with brakes, and steel end frames with integral twin jacks. Upright, Inc., 1775 Park St., Selma, Ca. 93662.

Source: Aviation Week & Space Technology, 12/19 Dec 1994, pg. 68.

Potential Apps: These stands appear to be lighter in weight than current inventory stands. The modularity feature allows two stands to be used together, thereby decreasing the number of different stands needed on a deployment. With slight modifications, this type of stand could be made with quick knock-down features and alignment tabs to permit stable stacking. The 12 inch casters would allow 3 to 4 units to be stacked and rolled on an airlifter as a single unit by the loadmaster.

Maintenance Stand	**Score: 182**	**Risk/Cost: 15-20**	
Deployment	**Score: 20**	**Risk/Cost: 15-20**	
	202		

357 Integrated OBOGS / OBIGGS Module for Aircraft

Synopsis: The Integrated OBOGS/OBIGGS module utilizes molecular sieve gas separation technology to process conditioned air from the ECS and electrical power from the aircraft system to produce oxygen-enriched air for pilot breathing and nitrogen/oxygen-depleted gas for fuel tank inerting. A built-in test (BIT) health-monitoring system under microprocessor control would detect faults, isolate them, and record data to warn the pilot of out-of-tolerance system or component conditions. The O2N2 concentrator uses pressure swing adsorbtion for gas separation using synthetic zeolite beds. The OBOGS portion of the integrated unit furnishes the pilot's O2, emergency O2, and bailout O2. Emergency and bailout O2 are automatically serviced by OBOGS. The OBIGGS portion of the system produces inert gas (N2) for fuel pressurization and inerting. Both systems are supplied conditioned air from the ECS with the flows and pressures regulated according to the requirements of each. Integration of microchip sensors for pressure, temperature, and flow with the components of the O2N2 concentrator module permits microprocessor control and detection of incipient failures. The concentrator monitor assembly will provide bit status information. The major components of the OBOGS /OBIGGS module include two N2 beds, two O2 beds, water separator, regulator, rotary valve, motor, accumulator, monitor assembly, and shutoff valve. The two oxygen beds alternate so that one is pressurized and is adsorbing nitrogen and producing oxygen-enriched gas, while the other is venting to ambient and desorbing nitrogen from the prior pressurization period. The regeneration by desorption of nitrogen in the vented bed is enhanced by a reverse flow of oxygen-enriched gas from the output or product end of the pressurized bed. The two oxygen beds are cycled alternately between the pressurization or oxygen-producing mode and the vented, regenerative, nitrogen-purging mode by the motor-driven rotary valve. The output oxygen-enriched product gas from the pressurized beds flows through check valves to a pressure smoothing plenum and on to the breathing-gas line. Similarly, the nitrogen beds alternate so that when one bed is pressurized and adsorbing oxygen and producing nitrogen-enriched inert gas, the other bed is regenerating by venting to ambient and desorbing oxygen from the prior pressurization period. No reverse purge flow for the vented bed is required. The output of the nitrogen-enriched, inert gas flows through check valves to the fuel tank inert gas lines. Transducers provide continuous signals to the concentrator monitor to detect off-limit and failure conditions. The system is completely self-contained, designed for one-man maintenance, has only one moving part, and saves weight, space, and money.

Source: Northrop's In-House 440 Technology Listing, 1985 & HRF, NOR 87-57, 1986.

Potential Apps: Many of today's military aircraft use either liquid oxygen (LOX) or high pressure gaseous oxygen systems. Both present many problems which inhibit both operations and economical logistics support. An aircraft can be refueled in flight to increase its range, however, that range is still limited by the oxygen supply. LOX, for example, cannot be replenished anywhere but on the ground, which requires costly equipment and personnel. The generation plants are not only costly, but difficult to maintain. They require power, a fuel source, and the generated LOX must be stored in unique, heavy and unwieldy thermal containers. These containers must then be transported to the using site. In turn, special servicing equipment is required to replenish the individual reservoirs in the aircraft. The OBOGS/OBIGGS module totally eliminates LOX servicing carts and other storage equipment.

Servicing	**Score: 179**	**Risk/Cost: 25-30**	

44 Low Cost Composite Advances for Aircraft Structures (Graphlite)

Synopsis: A team comprised of the University of Bristol, Cranfield University, British Aerospace Airbus Ltd., Reaction Engines Ltd., Westland Engineering Ltd., and Cookson Group plc will participate in a collective research program and has received a UK government grant to support this research. The grant will enable the consortium to examine unique new approaches to composite structures. The aim is to use more fully the impressive properties of composite materials and depends on the manufacture and joining of high-performance unidirectional struts. Three target applications have been identified: a wing box for a large transport aircraft, an aircraft floor beam, and a section of the fuselage for Skylon (a reusable spacecraft). Ther project objective is to design and manufacture demonstration

components for all the applications. A key part of the program is to investigate the performance of a new material form, called Graphlite, in to these components. The product, manufactured by NEPTCO Inc., is a unidirectional carbon fiber rod exhibiting some of the highest compressive properties ever recorded for composite materials. NEPTCO Graphlite carbon fiber rod will maximize axial strength and stiffness when used in spar caps and hat sections. Values of compressive strength of 2.65 Gpa and compressive strains of 1.7% are said to have been recorded by US aerospace manufacturers. The product has also received extensive testing and characterization under a US Air Force contract with Bell Helicopter. When Graphlite was incorporated in a composite wing stringer, manufacturing costs were reduced by 50%, post-impact compressive strength was doubled, and part consistency was improved when compared to conventional prepreg technology.

Source: Aerospace Engineering, Mar 1996, pg. 32.

Potential Apps: The evolution of SE design will eventually lead to the use of composite materials for certain applications, as it is extremely corrosion resistant, strong, durable, and lightweight. Proposed composite applications for SE have been chassis frames, running gear, hood enclosures, cargo pallets, maintenance stands and a wide variety of other SE components. One of the enabling technologies will undoubtedly be the development of more affordable composites, as cost and repairability are two of the largest issues for aircraft application, even when compared to the other exotic, custom-made aerospace metals.

Maintenance Stand	**Score:**	**164**	**Risk/Cost:**	**30-40**
Air Compressor	**Score:**	**102**	**Risk/Cost:**	**30-40**
Ground Power/Start Cart	**Score:**	**57**	**Risk/Cost:**	**30-40**
Air Conditioner	**Score:**	**51**	**Risk/Cost:**	**30-40**
General SE	**Score:**	**30**	**Risk/Cost:**	**30-40**
Deployment	**Score:**	**24**	**Risk/Cost:**	**30-35**
Hydraulic Equipment	**Score:**	**21**	**Risk/Cost:**	**30-40**
Lift Truck/Jammer	**Score:**	**18**	**Risk/Cost:**	**30-40**
Auxiliary Lighting	**Score:**	**17**	**Risk/Cost:**	**30-40**
Tow Vehicle/Truck	**Score:**	**5**	**Risk/Cost:**	**30-40**
		489		

300 Portable Environmental Control System (PECS) for Air Cooling & Heating

Synopsis: This unit, developed by Lear Astronics' Developmental Sciences Center in Ontario, Ca., is based on proven air cycle machine technology and requires no freon or electrical power. When used in conjunction with a -60 Generator Set or an Aircraft Ground Power Unit (AGPU), this unit provides cooling or heating air for support of aircraft ground maintenance operations. It has a low profile and can be set on the ground or mounted on top of the -60 or AGPU. The unit weighs 150 lbs with a volume of 9 cu. ft. This compares to 1,290 lbs and 302 cu. ft. for the AM 32C-10 Air Conditioner presently in the USAF inventory. Rated outputs are 40 lbs/min air flow, and a controllable temperature range of 40 to 200 deg F at 4 psig. Maximum cooling performance is 40 lbs/min at 45 deg F for these rated ambients: 103 deg F with 180 grains per pound at 70 percent relative humidity; 103 deg F with 130 grains per pound at 40 percent relative humidity; and 120 deg F with 25 grains per pound at 5 percent relative humidity. Anti-ice control is achieved automatically by a temperature sensor that monitors output air temperature and introduces hot bleed air into the system when required to prevent the accumulation of ice on the turbine. Modular construction permits removal of the PECS system as a single unit, and maintenance is reduced by eliminating coalescer bags in the low pressure portion of the system. Water is extracted at three locations in the high pressure portion of the system and requires no maintenance.

Source: Composite Wing Future Requirements Study, Northrop Corp, Aug 93, pp. 19-20.

Potential Apps: PECS is extremely lightweight, and by itself, has an extremely small footprint. When placed on top of the pneumatic power source, the small increase in volume is negligible because it is height that is increased and not length or width. Height is seldom a limiting discriminator. Length and width are the major contributors in reaching the volume capacity of a C-141. The unit requires no electrical power and modular construction permits removal of the Air Cycle Machine as a single unit. Several units have been produced by Lear Astronics and sold to the Japanese Self Defense Force. Additional units were ordered by the US Government for the Desert Shield force buildup, but contract deliveries were canceled due to time schedule constraints.

Air Conditioner	**Score:**	**159**	**Risk/Cost:**	**0-5**

35 Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts

Synopsis: Resin transfer molding involves the use of carbon fibers to reinforce epoxy and other resins. The process results in greater quality, increased production rates, and an ability to manufacture more complex, yet less costly parts, than in the past. Dow-United Technologies Products, Inc. was created in 1989 to develop an advanced process for manufacturing composite parts for aerospace applications. The company was created as a joint venture between Dow Chemical Company and United Technologies Corp. Recently, the technique which they developed, advanced resin transfer molding, was used to complete a jet engine fan exit case, the first ever built from composites. The program is funded through a contract from the Defense Department's Advanced Research Projects Agency, under a Technology Reinvestment Project called Affordable Composites for Propulsion. Results from the work developed under the program are being used to introduce the cost and weight benefits afforded by this technology directly into Pratt's F119 engine (used for

the Air Force F-22 fighter) and into its family of commercial aircraft engines.

Source: Aerospace Engineering, April 1996, pg. 15.

Potential Apps: The potential application of composite parts for aircraft is expanding to a larger variety of components, however, available long-term field data is limited to selected airframe panels and wing components. As the maintainability knowledge base grows and the associated cost of manufacture declines, composites will undoubtedly be applied to a variety of support equipment, such as panels, cabs, frames and other structural members. Composite parts for SE must consider the problems experienced with aircraft components. Resin transfer molding appears to hold promise for lower cost of manufacture.

Maintenance Stand	**Score:**	**148**	**Risk/Cost:**	**30-40**
Air Compressor	**Score:**	**102**	**Risk/Cost:**	**30-40**
Ground Power/Start Cart	**Score:**	**57**	**Risk/Cost:**	**30-40**
Air Conditioner	**Score:**	**51**	**Risk/Cost:**	**30-40**
General SE	**Score:**	**30**	**Risk/Cost:**	**30-40**
Deployment	**Score:**	**24**	**Risk/Cost:**	**30-35**
Hydraulic Equipment	**Score:**	**21**	**Risk/Cost:**	**30-40**
Lift Truck/Jammer	**Score:**	**18**	**Risk/Cost:**	**30-40**
Auxiliary Lighting	**Score:**	**17**	**Risk/Cost:**	**30-40**
Tow Vehicle/Truck	**Score:**	**5**	**Risk/Cost:**	**30-40**
		473		

36 Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material

Synopsis: DuPont Singapore, Pte. Ltd. is participating in a newly formed joint project to develop technologies and methods for using advanced thermoplastic composites to repair thermoset composites used in the aircraft industry. A memorandum of understanding has been completed for the $1.2 million effort among DuPont Singapore, the National University of Singapore, and Singapore Technologies Aerospace Ltd. The project is funded by Singapore's National Science and Technology Board. The project combines the university's knowledge of structural analysis and design with DuPont's expertise in advanced theroplastic composites. The first stage involves defining the specific repair difficulties faced by aircraft operators concerning advanced materials and developing application hardware and thermoplastic parts for in-flight trials. The second stage involves generating in-flight data for certification, followed by the final stage of international airworthiness certification by appropriate authorities.

Source: Aerospace Engineering, Apr 1996, pg. 16.

Potential Apps: The potential application of composite parts for SE (panels, cabs, frames and other structural members) must consider the problems experienced with aircraft components. According to an American Airlines senior engineer, "part of the problems with composite components is self-induced. Damage to composite parts, just like their metal counterparts, results from mishaps with baggage carts and other ground equipment. But the thing the that irritates me and others the most is the non-performance of a part because of its inability to perform in the environment in which it works". As more reliable and economical methods of field repair are discovered, wider application of composite components for SE will be realized.

Maintenance Stand	**Score:**	**148**	**Risk/Cost:**	**30-40**
Air Compressor	**Score:**	**102**	**Risk/Cost:**	**30-40**
Ground Power/Start Cart	**Score:**	**57**	**Risk/Cost:**	**30-40**
Air Conditioner	**Score:**	**51**	**Risk/Cost:**	**30-40**
General SE	**Score:**	**30**	**Risk/Cost:**	**30-40**
Hydraulic Equipment	**Score:**	**17**	**Risk/Cost:**	**30-40**
Auxiliary Lighting	**Score:**	**17**	**Risk/Cost:**	**30-40**
Lift Truck/Jammer	**Score:**	**12**	**Risk/Cost:**	**30-40**
Tow Vehicle/Truck	**Score:**	**5**	**Risk/Cost:**	**30-40**
		439		

188 New Fiberglass Polymer Composite Using Lower-Cost Raw Materials

Synopsis: A prototype fiberglass polymer, short-span highway bridge designed by Lockheed Martin has successfully held a 32.5-ton personnel carrier. The growing need for cost-effective bridges to replace aging US highway infrastructure could supercharge the composites industry, significantly lowering raw material prices for other users. Composite bridges are corrosion-resistant and easier to site owing to their light weight. Portable versions also have potential military and disaster-relief markets. Lockheed Martin's Palo Alto Research Laboratories designed, analyzed and built a 18 x 30-ft. test span in less than 18 months, including five weeks' fabrication time by two local fiberglass shops. Materials cost for the 23,000-lb. structure was less than $5/lb.

Source: Aviation Week & Space Technology, 20 Nov 1995, pg. 21.

Potential Apps: Composites will eventually have a place in the manufacture of support equipment when the affordability, durability and ease-of-repair of composite aircraft components have been thoroughly optimized. Possible SE applications include turbine engine exhaust stacks, heater flues, replacement for sheetmetal enclosures, structural members, and doors and panels prone to vibrational cracking or environmentally-induced corrosion. Application of this particular composite material may bridge that gap.

Maintenance Stand	**Score:**	**148**	**Risk/Cost:**	**30-40**
Air Compressor	**Score:**	**102**	**Risk/Cost:**	**30-40**
Ground Power/Start Cart	**Score:**	**57**	**Risk/Cost:**	**30-40**
Air Conditioner	**Score:**	**51**	**Risk/Cost:**	**30-40**
General SE	**Score:**	**30**	**Risk/Cost:**	**30-40**
Deployment	**Score:**	**24**	**Risk/Cost:**	**30-35**
Hydraulic Equipment	**Score:**	**21**	**Risk/Cost:**	**30-40**
Lift Truck/Jammer	**Score:**	**18**	**Risk/Cost:**	**30-40**
Auxiliary Lighting	**Score:**	**17**	**Risk/Cost:**	**30-40**
Tow Vehicle/Truck	**Score:**	**5**	**Risk/Cost:**	**30-40**
		473		

198 Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics

Synopsis: UltraFine II Antimony Oxide from Laurel Industries is used as a flame retardant in manufacturing thermoplastics, thermosets, and synthetic fabrics. Its submicron particle size (0.4mm) makes it ideal for applications requiring a minimum loss of physical property. Used as a synergist in flame-retarded thermoset resins, it reduces the tendency of antimony oxide to settle during processing before the resin is cured. The product is ideally suited for flame-retarding monofilament synthetic fibers because submicron particles will not plug filters or spinnerettes.

Source: Aerospace Engineering, Aug 1996, pg. 18.

Potential Apps: With the wide spread application of composite materials in flightline SE, it would appear to be very desirable to have composite components that are fire retardant. This would minimize the possibility of a "Corker" incident when composite materials burn and release long, thin floating carbon filaments in the atmosphere which immediately settle in and short out electrical and electronic systems. Open cockpits are especially susceptible to Corker hazards.

Maintenance Stand	**Score:**	**148**	**Risk/Cost:**	**30-40**
Air Compressor	**Score:**	**102**	**Risk/Cost:**	**30-40**
Ground Power/Start Cart	**Score:**	**57**	**Risk/Cost:**	**30-40**
Air Conditioner	**Score:**	**51**	**Risk/Cost:**	**30-40**
General SE	**Score:**	**30**	**Risk/Cost:**	**30-40**
Auxiliary Lighting	**Score:**	**17**	**Risk/Cost:**	**30-40**
Hydraulic Equipment	**Score:**	**17**	**Risk/Cost:**	**30-40**
Lift Truck/Jammer	**Score:**	**12**	**Risk/Cost:**	**30-40**
Tow Vehicle/Truck	**Score:**	**5**	**Risk/Cost:**	**30-40**
		439		

202 BFGoodrich's TempRite Low-Combustibility Thermoplastics

Synopsis: BFGoodrich has introduced TempRite LC low-combustibility thermoplastics designed for smoke and flame-regulated environments. The product is available in sheet form as well as in compounds for profile extrusion and custom injection molding. Thermoformable with conventional ABS technology, the sheet products offer deep draw capability with superior texture retention, and are available in a wide variety of colors and decorative options. They also maintain durability and stability at elevated service temperatures and offer broad chemical resistance. They meet or exceed FAR 25.853, FTA/UMTA, and Model Building Code Class A or 1, making the products suitable for applications such as commercial aircraft and mass transit interiors.

Source: Aerospace Engineering, Jan/Feb 1995, pg. 35.

Potential Apps: With the wide spread application of composite materials in flightline SE, it would appear to be very desirable to have composite components that are fire retardant. This would minimize the possibility of a "Corker" incident when composite materials burn and release long, thin floating carbon filaments in the atmosphere which immediately settle in and short out electrical and electronic systems. Open cockpits are especially susceptible to Corker hazards.

Maintenance Stand	**Score:**	**148**	**Risk/Cost:**	**30-40**

Air Compressor	**Score:**	**102**	**Risk/Cost:**	**30-40**
Ground Power/Start Cart	**Score:**	**57**	**Risk/Cost:**	**30-40**
Air Conditioner	**Score:**	**51**	**Risk/Cost:**	**30-40**
General SE	**Score:**	**30**	**Risk/Cost:**	**30-40**
Auxiliary Lighting	**Score:**	**17**	**Risk/Cost:**	**30-40**
Hydraulic Equipment	**Score:**	**17**	**Risk/Cost:**	**30-40**
Lift Truck/Jammer	**Score:**	**12**	**Risk/Cost:**	**30-40**
Tow Vehicle/Truck	**Score:**	**5**	**Risk/Cost:**	**30-40**
		439		

280 Rigid-Rod Polymer Plastics for Structural Metal Replacements

Synopsis: Maxdem, Inc., San Dimas, Calif., is seeking development partners for an entirely new family of rigid-rod polymers it created that are over four times stiffer than conventional plastic materials. Known as Poly-X-Self-Reinforced Polymers, the cheap and durable materials have the potential to replace structural metals, including aluminum and stainless steel, in aerospace and defense applications. It also can substitute for expensive fiber-reinforced composite parts, according to Matthew Marrocco, company vice president of research and development. Poly-X can be molded using injection, extrusion or compression processes. Estimated cost of Poly-X is $10-12/lb. when in full production, with structural foams, coatings, films and membranes possible.

Source: Aviation Week & Space Technology, 20 Mar 1995, pg. 15.

Potential Apps: The design of composite parts of commercial aircraft is shifting from a focus on reducing weight for maximum performance to a more balanced approach in which durability and repairability have a higher priority. This shift comes in the wake of complaints about delaminated advanced composite parts due to moisture ingression, as well as problems commercial airlines are having with composite repairs. The Poly-X product appears to address these concerns (as well as the infamous affordability issues of composites) which would make it an ideal candidate for structural members in support equipment. Lack of corrosion resistance, metal fatigue and poor structural durability are universal complaints for nearly all support equipment, including the lowly maintenance stand.

Maintenance Stand	**Score:**	**148**	**Risk/Cost:**	**30-40**
Air Compressor	**Score:**	**102**	**Risk/Cost:**	**30-40**
Ground Power/Start Cart	**Score:**	**57**	**Risk/Cost:**	**30-40**
Air Conditioner	**Score:**	**51**	**Risk/Cost:**	**30-40**
General SE	**Score:**	**30**	**Risk/Cost:**	**30-40**
Deployment	**Score:**	**24**	**Risk/Cost:**	**30-40**
Hydraulic Equipment	**Score:**	**21**	**Risk/Cost:**	**30-40**
Auxiliary Lighting	**Score:**	**17**	**Risk/Cost:**	**30-40**
Lift Truck/Jammer	**Score:**	**12**	**Risk/Cost:**	**30-40**
Tow Vehicle/Truck	**Score:**	**5**	**Risk/Cost:**	**30-40**
		467		

306 Composite Vehicle Structure

Synopsis: Cost-effective polymer composite structures that exhibit "crush control" in crash tests are being developed to compete with mass-produced steel car bodies. Practical plastic car bodies came a step closer to reality when an automotive front-end section built from glass-fiber-reinforced polymer composites passed a key 35-mile-per-hour barrier crash test. The tests were conducted earlier this year by the Automotive Composites Consortium (ACC), a precompetitive research partnership established by the Big Three American automakers--Chrysler, Ford, and General Motors--and their suppliers to integrate advanced composite materials into car structures. ACC engineers installed the experimental composite assembly in a steel Ford Escort, fitted it with sensors, and sent the test vehicle crashing into a wall as high-speed cameras recorded the impact in detail. "This was the first demonstration that a composite front-end structure, designed for mass-production manufacturing, could display outstanding energy-management performance," said Alan Taub, ACC board director and manager of the Materials Science Department at the Ford Research Laboratory in Dearborn, Mich. In the past, Taub said, hand-laid-up composite front-end units had displayed this capability, but they were only technical feasibility demonstrations. The crash tests, the culmination of the ACC's focal project 1, showed that composites can manage the energy of vehicle crashes as safely as steel, according to John Fillion, an ACC board director and manager of organic materials engineering at Chrysler Corp. in Auburn Hills, Mich. "There is no safety trade-off when you replace steel with a correctly designed composite part." When a car crashes, Fillion explained, the goal is for the structure to fail in a relatively gradual, predictable way that absorbs much of the impact energy, keeping it away from the occupants. The trick in crash-energy management is to create what's called a controlled crush. When an appropriately designed composite part--typically a stiff, hollow tube—is hit on the end, it tends to tear down its length in several places around the tube's perimeter in an effect called flowering. In flowering, fracture structures that look like flower petals form and spread out from the tube's central axis. This kind of tube cracking absorbs much more impact energy than does a clean break into a few pieces, as composite parts tend to do. Cost-effective mass production of large, complex composite components will require the use of low-cost, high-reliability materials; new high-speed processing techniques; and new structural design approaches tailored for

fiber-reinforced polymer materials. ACC engineers are focusing on liquid-molding techniques including resin transfer molding (RTM) and structural-reaction injection molding (SRIM). The effort's primary material systems are vinyl esters and polyurethanes, reinforced with inexpensive chopped-glass rovings. Automated glass-fiber preforming processes and high-rate molding procedures are being studied in an effort to reduce cycle times and production costs substantially.

Source: The American Society of Mechanical Engineers, Mechanical Engineering Magazine, 12/96, Internet.

Potential Apps: Cost-effective polymer composite structures can be applied to any tow vehicle or support equipment enclosure. Composites of this nature could also be applied to towbars, etc.

Maintenance Stand	**Score:**	**148**	**Risk/Cost:**	**30-40**
Air Compressor	**Score:**	**102**	**Risk/Cost:**	**30-40**
Ground Power/Start Cart	**Score:**	**57**	**Risk/Cost:**	**30-40**
Air Conditioner	**Score:**	**51**	**Risk/Cost:**	**30-40**
General SE	**Score:**	**30**	**Risk/Cost:**	**30-40**
Deployment	**Score:**	**24**	**Risk/Cost:**	**30-35**
Hydraulic Equipment	**Score:**	**21**	**Risk/Cost:**	**30-40**
Lift Truck/Jammer	**Score:**	**18**	**Risk/Cost:**	**30-40**
Auxiliary Lighting	**Score:**	**17**	**Risk/Cost:**	**30-40**
Tow Vehicle/Truck	**Score:**	**5**	**Risk/Cost:**	**30-40**
		473		

337 Thermoforming for Fabricating Lightweight Structural Composite Materials

Synopsis: The ability to produce high-quality, lightweight structural parts quickly with complex shapes promises to make thermoforming competitive with conventional metal-stamping methods. Thermoforming, the press-forming of continuous fiber-reinforced-thermoplastic (FRTP) sheets, is a promising for fabricating lightweight structural composite components. Thermoplastic polymers offer improved mechanical and physical properties compared with thermoset polymers, and perhaps most important for industry, they make rapid part production possible using the press-forming process. Despite its promise, thermoforming has not been used to its full potential because tool designers generally rely on costly and inefficient trial and error methods to obtain a detailed understanding of how this process lends itself to producing a particular part and so typically cannot gain the sophisticated understanding of the process needed to optimize it. An explicit finite-element code has been developed to simulate the thermoforming process, thereby enabling tool designers to experiment on a computer. The codes permit the analysis of certain classes of FRTP materials, including preconsolidated, stacked, continuous fiber-reinforced-thermoplastic materials having either unidirectional or woven fabrics. They used detailed temperature-dependent rheological models to account for intraply shearing, squeeze flow, fiber reorientation, and fiber buckling. They also rely on advanced friction laws, both temperature and pressure-dependent and pressure-dependent, to account for the interply sliding mechanism between plies. A commercial metal-stamping simulation tool that uses an explicit finite-element solution - PAM-STAMP, developed by the ESI Group in Paris - has been extended to handle such problems. ESI's approach is to model each ply independently using shell finite elements, and impose an interface viscous-friction law to govern the interply sliding between the individual plies. This approach correctly accounts for all the important forming mechanisms except percolation, which is considered unlikely in rapid press forming of high-quality structural parts.

Source: Mechanical Engineering Magazine, Thermoforming Simulation with FEA, Sep 96.

Potential Apps: With this Thermoforming process, tool designers can more carefully control the forming temperature and pressure cycles of these materials. Such control is critical to producing high-quality, lightweight, complex-shaped structural parts within a short cycle time, thus making thermoforming of lightweight composite parts competitive with conventional metal-stamping methods.

Maintenance Stand	**Score:**	**148**	**Risk/Cost:**	**30-40**
Air Compressor	**Score:**	**102**	**Risk/Cost:**	**30-40**
Ground Power/Start Cart	**Score:**	**57**	**Risk/Cost:**	**30-40**
Air Conditioner	**Score:**	**51**	**Risk/Cost:**	**30-40**
General SE	**Score:**	**30**	**Risk/Cost:**	**30-40**
Hydraulic Equipment	**Score:**	**17**	**Risk/Cost:**	**30-40**
Auxiliary Lighting	**Score:**	**17**	**Risk/Cost:**	**30-40**
Lift Truck/Jammer	**Score:**	**12**	**Risk/Cost:**	**30-40**
Tow Vehicle/Truck	**Score:**	**5**	**Risk/Cost:**	**30-40**
		439		

358 Thermoplastic Repairs By Bonding With Induction Heating

Synopsis: Use of magnetic heat induction repair systems and adhesives with short cure times will permit field level repairs of thermoplastic composite (TPC) structures. Small patch repair kits will be developed containing varying sizes of patches made from preconsolidated thermoplastic laminates. Thermoplastic laminate patches which are bonded-on are preferred to bolt-on patches as they will restore more of the structural integrity to the damaged area. The bonded patch method allows quick repairs to be made with good bond strength and without warping and deconsolidation. This is best accomplished by heating and melting the thermoplastic on the bond surfaces only, and then pressing the parts together. With the induction heating method, a single ply of nickel-coated graphite fibers or a metal screen is wrapped with the adhesive and placed between the two pieces to be bonded. The heat is created by a magnetic field generating eddy currents within the screen or graphite fibers which then dissipate due to internal electrical resistance. The bonding pressure is applied by blind rivets for field repairs and by vacuum bag at the depot. This advanced repair capability should significantly enhance system readiness, particularly during dispersed or austere operations where little or no support equipment is present.

Source: Northrop's In-House 220 Technology Listing & HRF, NOR 87-57, 1985.

Potential Apps: The application of composite materials in the construction of support equipment is slowly approaching reality, due mainly to the advent of thermoplastics. Thermoplastics are relatively new in the area of composites, but have a greater potential than thermoset composites for reduced acquisition costs, lower life cycle costs, better damage tolerance, and numerous supportability advantages. The most unique characteristic of a thermoplastic composite is evident only after a part has been formed. When heated back to 700 deg F, the part itself can be reformed to a different shape or bonded with several other pieces to form an integrated structure. A thermoset part will remain in a set shape and cannot be changed in such a manner. The reduction in fabrication costs of thermoplastic composites can be obtained through innovative and rapid forming processes in contrast to the long processing cycles typical of thermoset materials. Thermoplastics have no requirement for refrigeration of prepreg material and minimal requirements for ancillary tooling and repair materials such as vacuums, bleeders, and sealants. Other advantages include improved damage tolerance, rapid repairability, and reduced moisture pick-up/degradation. When the time arrives for support equipment made of TPC material, a good repair kit will be needed.

Maintenance Stand	**Score:**	**148**	**Risk/Cost:**	**30-40**
Air Compressor	**Score:**	**102**	**Risk/Cost:**	**30-40**
Ground Power/Start Cart	**Score:**	**57**	**Risk/Cost:**	**30-40**
Air Conditioner	**Score:**	**51**	**Risk/Cost:**	**30-40**
General SE	**Score:**	**30**	**Risk/Cost:**	**30-40**
Auxiliary Lighting	**Score:**	**17**	**Risk/Cost:**	**30-40**
Hydraulic Equipment	**Score:**	**17**	**Risk/Cost:**	**30-40**
Lift Truck/Jammer	**Score:**	**12**	**Risk/Cost:**	**30-40**
Tow Vehicle/Truck	**Score:**	**5**	**Risk/Cost:**	**30-40**
		439		

22 Self-Generating Nitrogen Through Hollow Fiber Membrane Technology

Synopsis: Four commercial companies have been identified that produce SE units which can self-generate nitrogen gas. These companies are Zwick Energy Research, Huntington Beach, CA; Keco Industries, Inc., Florence, Ky; CVB, Torrance, CA; and RIX Industries, Oakland, CA. The Keco self-generating nitrogen cart combines air separation technology with existing flightline air compressors. "High Pac" air compressors (MC-1A) can be converted to a nitrogen generator by incorporating the Generon GL nitrogen generating hollow fiber membrane module. The output is a constant supply of dry, gaseous nitrogen. The Keco model 4MC-1A is a portable, trailer-mounted, self-contained unit that is powered by an air cooled diesel engine that drives a reciprocating 4-stage, 4-cylinder compressor. It is equipped with dual high pressure storage cylinders capable of supplying 15 SCFM for 14.7 minutes with the generator operating. It has a built-in regulator with capacity from 50 to 4,000 psi. Additionally, this unit was used by the US Army in Operation Desert Storm and is used by the USAF at Andrews AFB, Md.

Source: Composite Wing Future Requirements Study, Northrop Corp, Aug 93, pp. 17-18

Potential Apps: Multifunction capability is achieved by using this self-generating nitrogen technology, as it also provides both low and high pressure air required by for flightline maintenance activities. Self-generating nitrogen technology can eliminate the need for liquid nitrogen and the associated expense of operating, storing, transporting this commodity. An 18 PAA squadron of F-16 fighters currently deploys with two liquid nitrogen servicing carts and one gaseous nitrogen servicing cart, which have a cumulative weight of 8,260 lbs. The Generon membrane has no moving parts and requires minimal maintenance. Every existing MC-1A can be modified with the membrane module with no compressor or engine modifications necessary. High pressure inert gas is used for servicing landing gear struts, aircraft tires, hydraulic accumulators and other subsystems requiring dry, high pressure inert gas. These units are available now and new units are offered in electric or diesel driven models.

Servicing	**Score:**	**143**	**Risk/Cost:**	**25-40**

185 Carbon Foam Material for Insulation, High-Temp Filters and Engine Parts

Synopsis: A novel carbon foam material has been developed by Ultramet Inc., Pacoima, California. Potential aerospace applications include insulation, re-entry protection and high-temperature filters as well as certain engine components such as heat exchangers and catalytic igniters. The lightweight foam can be infiltrated with metal or ceramic materials to optimize strength, stiffness, permeability, conductivity

and other characteristics, according to Robert Tuffias, company general manager.

Source: Aviation Week & Space Technology, 13 Nov 1995, pg. 13.

Potential Apps: There are many instances of cracking and coking within the high temperature components of flightline heaters, as well as gas turbine engines. New metallurgy in turbine engine design will improve the performance, efficiency and durability of these units.

Heater	**Score:**	**133**	**Risk/Cost:**	**50-55**
Air Compressor	**Score:**	**12**	**Risk/Cost:**	**75-80**
Lift Truck/Jammer	**Score:**	**7**	**Risk/Cost:**	**75-80**
		152		

262 Portable Computer Diagnostic System for F-16 Flightline Maintenance

Synopsis: South Korea will use a portable computer diagnostic system for flightline maintenance of its F-16 aircraft. The three box system, produced by Paravant Computer Systems Inc., of Melbourne, Fla., replaces what previously took 31 pieces of test equipment for the F-16. For most preflight and troubleshooting, a technician needs only to take two of the boxes which one person can carry. The system could be used by a variety of modern aircraft, with software tailored for each one, according to Paravant. About four foreign military sales are in the works, with the Korean order of 25 leading the way. The US Air Force has ordered five for its F-16s and two for the B-2, according to Paravant.

Source: Aviation Week & Space Technology, 19 Jun 1995, pg. 58.

Potential Apps: Although the technology synopsis fails to identify the name, size or weight of the 31 test sets it is replacing, the Paravant diagnostic system embodies the SEEIT philosophy of multifunctionality to reverse the SE diversity and proliferation out on the flightline. Obviously, the Paravant system has been thoroughly tested for functionality and has been accepted as equal or superior to the individual test sets being replaced. This computer diagnostic system could conceivably be expanded to other MDS aircraft in the USAF inventory, such as A10s, F-117s, F-15s, C-130s, C-141s, C-5s, C-17s, KC-135s, KC-10s, B-52s and B-1s.

Test Set	**Score:**	**133**	**Risk/Cost:**	**45-50**

218 Maxi-Heat Portable Heater and Generator for Isolated Job Sites

Synopsis: The Maxi-Heat portable heater and generator provides up to 1 million BTUs per hour of clean, heated air at isolated job sites. Combustion gases from the enclosed burners are exhausted away from the machine, while clean, warm air is directed toward the work area. The Maxi-Heat can generate a maximum of 5,600 cu.ft./minute with up to a 180F temperature rise at sea level. The device is powered by an 1,899-rpm Lister air-cooled diesel engine. Its 191 gal. fuel tank allows unattended operation for up to 24 hours. The machine also produces 120 or 240 VAC power. Allmand Bros. Inc., P.O. Box 888, Holdrege, Neb. 68949.

Source: Aviation Week & Space Technology, 5 Feb 1996, pg. 106.

Potential Apps: There are many problems with the present inventory H-1 heater. Some of the more salient problems are inconsistent fuel metering, contaminated hot air, burners that foul, hard starting, cracked heat exchangers, sooty operation and hang fires. A complete switch-over to a modern, efficient unit is needed to eliminate these types of discrepancies.

Heater	**Score:**	**128**	**Risk/Cost:**	**15-20**

27 Reduced Maintenance Batteries

Synopsis: Reduced Maintenance Batteries will soon be available for in-service Boeing 737, 747, 757 and 767 transports. Eldec Corp of Lynnwood, Wash., is working with several battery manufacturers to develop advanced nickel-cadmium main batteries and related inflight charging system modification kits. The new batteries will not need maintenance for at least two years, compared with every three months in current high-use transports. Although initially more expensive, the new battery system will reduce maintenance, handling and disposal problems. A future zero maintenance version will allow airlines to drop expensive battery overhaul shops.

Source: Aviation Week & Space Technology, 27 September 1993, pg. 17

Potential Apps: Gel batteries are presently in use on the USAF flightline, but feedback indicates they have problems of their own. Cold weather cranking power is lacking in the new gels. New battery technology is needed to increase performance and battery life. At present, the business of supplying battery replacements for DoD agencies is a lucrative one. During 1995, the US Army alone spent $77.2 million on 300 different types of batteries.

Misc In-Shop Equipment	**Score:**	**121**	**Risk/Cost:**	**70-80**
Environmental	**Score:**	**26**	**Risk/Cost:**	**70-80**
Lift Truck/Jammer	**Score:**	**22**	**Risk/Cost:**	**70-80**
Auxiliary Lighting	**Score:**	**21**	**Risk/Cost:**	**70-80**
Hydraulic Equipment	**Score:**	**18**	**Risk/Cost:**	**70-80**
General SE	**Score:**	**18**	**Risk/Cost:**	**70-80**

Air Compressor	**Score:**	**18**	**Risk/Cost:**	**70-80**
Ground Power/Start Cart	**Score:**	**10**	**Risk/Cost:**	**70-80**
Special Purpose Flightline	**Score:**	**8**	**Risk/Cost:**	**70-80**
		262		

78 Lithium Solid Polymer Electrolyte Batteries

Synopsis: The US Advanced Research Project Agency (ARPA) awarded a $3M contract to Alliant Techsystems for the manufacture and prototyping of lithium solid polymer electrolyte rechargeable ambient temperature batteries. The contract is divided into two parts, running concurrently over 24 months, with the US Office of Naval Research acting as procurement agent. The larger share of the award focuses on processes and the manufacturing technology associated with polymer battery electrochemistry, while the other portion centers on finding ways to improve performance and on researching alternate battery materials. Military applications include manportable battlefield electronics, such as night vision goggles and communications.

Source: Jane's Defence Contracts, Dec 1994, pp. 11-12.

Potential Apps: The US Armed Forces have long recognized the need for better battery technologies. Ideally, a battery would be composed of non-toxic materials, be infinitely rechargeable with none of the weight, safety and environmental concerns associated with metal-based batteries. Gel batteries, in use today on the USAF flightline, have problems with cold weather cranking. At present, the business of supplying battery replacements for DoD agencies is a lucrative one. During 1995, the US Army alone spent $77.2 million on 300 different types of batteries.

Misc In-Shop Equipment	**Score:**	**121**	**Risk/Cost:**	**70-80**
Environmental	**Score:**	**26**	**Risk/Cost:**	**70-80**
Lift Truck/Jammer	**Score:**	**22**	**Risk/Cost:**	**70-80**
General SE	**Score:**	**18**	**Risk/Cost:**	**70-80**
Hydraulic Equipment	**Score:**	**18**	**Risk/Cost:**	**70-80**
Air Compressor	**Score:**	**18**	**Risk/Cost:**	**70-80**
Ground Power/Start Cart	**Score:**	**10**	**Risk/Cost:**	**70-80**
Special Purpose Flightline	**Score:**	**8**	**Risk/Cost:**	**70-80**
Auxiliary Lighting	**Score:**	**6**	**Risk/Cost:**	**70-80**
		247		

133 All-Plastic Battery

Synopsis: All-plastic batteries can be recharged hundreds of times and operate under extreme hot and cold temperature conditions without serious performance degradation. The finished cell can be as thin as a business card and malleable, allowing battery manufacturers to cut a cell to a specific space or make the battery the actual case of the device to be powered.

Source: NASA Tech Briefs/October 1996

Potential Apps: Applications include: powering GPS receivers, communication transceivers, remote sensors, backup power systems, cellular phones, pagers, computing products, and other portable equipment. Potential larger application include remote monitoring stations, highway communication signs, and electric vehicles.

Misc In-Shop Equipment	**Score:**	**121**	**Risk/Cost:**	**70-80**
Environmental	**Score:**	**26**	**Risk/Cost:**	**70-80**
Lift Truck/Jammer	**Score:**	**22**	**Risk/Cost:**	**70-80**
General SE	**Score:**	**18**	**Risk/Cost:**	**70-80**
Hydraulic Equipment	**Score:**	**18**	**Risk/Cost:**	**70-80**
Air Compressor	**Score:**	**18**	**Risk/Cost:**	**70-80**
Ground Power/Start Cart	**Score:**	**10**	**Risk/Cost:**	**70-80**
Special Purpose Flightline	**Score:**	**8**	**Risk/Cost:**	**70-80**
Auxiliary Lighting	**Score:**	**6**	**Risk/Cost:**	**70-80**
		247		

155 High Reliability Maintenance-Free Battery

Synopsis: The technology of using recombined oxygen-starved electrolytes in sealed lead-acid batteries produces a High Reliability Maintenance-Free Battery (HRMFB). The battery's porous plate separator material retains the acid. There is no free liquid acid in the battery. This design increases the amount of active material per unit volume, resulting in a higher capacity battery in that same size

case, along with significant weight reduction over current flooded lead-acid and Nickel-Cadium (Ni-Cad) batteries. The battery can replace existing flooded lead-acid batteries and is a candidate to replace expensive, maintenance-intensive Ni-Cad batteries in many aircraft.

Source: Tech Tip-An Air Force Publication/1 July 1992

Potential Apps: C-141, A-10, KC-135, and Ground Support Equipment.

Misc In-Shop Equipment	**Score:**	**121**	**Risk/Cost:**	**70-80**
Environmental	**Score:**	**26**	**Risk/Cost:**	**70-80**
Lift Truck/Jammer	**Score:**	**22**	**Risk/Cost:**	**70-80**
Hydraulic Equipment	**Score:**	**18**	**Risk/Cost:**	**70-80**
Air Compressor	**Score:**	**18**	**Risk/Cost:**	**70-80**
General SE	**Score:**	**18**	**Risk/Cost:**	**70-80**
Ground Power/Start Cart	**Score:**	**10**	**Risk/Cost:**	**70-80**
Special Purpose Flightline	**Score:**	**8**	**Risk/Cost:**	**70-80**
Auxiliary Lighting	**Score:**	**6**	**Risk/Cost:**	**70-80**
		247		

233 Solar Power to Extend Battery Life (Solargizers)

Synopsis: Dead batteries have long plagued military units' readiness, not to mention the efforts and costs involved in replacing and disposing of them. Pulse-Tech Products Corp has developed a small, inexpensive device that uses solar power to extend battery life by up to five times. Modified transformers and circuit boards, powered by either a 115V or 220V AC power source, can work the same magic for batteries installed in vehicles stored in shelters or otherwise out of direct sunlight. Pulse-Tech's Solargizer extends battery life by converting sunlight (or AC power) to a low power pulse charge that ends the process of sulfation in batteries. Sulfation occurs as a battery loses its energy through discharging, allowing a crystallized sulfate formation to build up on the battery's lead plates. How well does the Solargizer work? The US Army Research Laboratory gave it a thumbs up and the Army Materiel Command has endorsed the use of pulse technology for the Army's military equipment that uses lead acid batteries. The US Army has a goal of reducing battery-related expenditures by 50 percent. Last year, the Army spent $77.2M on 300 different types of batteries.

Source: Armed Forces Journal International, Aug 1996, pg. 18.

Potential Apps: The Army is involved in a number of initiatives to reduce battery-related expenditures. It is awarding contracts which are moving toward maintenance-free vehicle batteries, buying inexpensive battery testers, and at Fort Hood, there's a major effort underway with Solargizers. The results have shown that they have made a difference.

Misc In-Shop Equipment	**Score:**	**121**	**Risk/Cost:**	**15-20**
Environmental	**Score:**	**26**	**Risk/Cost:**	**15-20**
Lift Truck/Jammer	**Score:**	**22**	**Risk/Cost:**	**15-20**
Air Compressor	**Score:**	**18**	**Risk/Cost:**	**15-20**
Hydraulic Equipment	**Score:**	**18**	**Risk/Cost:**	**15-20**
General SE	**Score:**	**18**	**Risk/Cost:**	**15-20**
Ground Power/Start Cart	**Score:**	**10**	**Risk/Cost:**	**15-20**
Special Purpose Flightline	**Score:**	**8**	**Risk/Cost:**	**15-20**
Auxiliary Lighting	**Score:**	**6**	**Risk/Cost:**	**15-20**
		247		

238 All-Plastic, Solid State Battery

Synopsis: An all-plastic battery has been developed by the US Air Force's Rome (N.Y.) Laboratory and researchers at Johns Hopkins University's Applied Physics Laboratory. The solid-state battery, intended to be molded into almost any size and shape, uses a plastic anode, cathode and electrolyte. Tests on a prototype indicate the battery, which is composed of non-toxic materials, can be recharged up to 100 times. The technology, while still at an early stage, eventually could help eliminate weight, safety and environmental concerns associated with metal-based batteries.

Source: Aviation Week & Space Technology, 4 Mar 1996, pg. 13.

Potential Apps: Gel batteries are in use on the USAF flightline, but feedback indicates they have problems of their own. Cold weather cranking power is lacking in the new gels. New battery technology is needed to increase performance and battery life. At present, the business of supplying battery replacements for DoD agencies is a lucrative one. During 1995, the US Army alone spent $77.2 million on 300 different types of batteries.

Misc In-Shop Equipment	**Score:**	**121**	**Risk/Cost:**	**70-80**
Environmental	**Score:**	**26**	**Risk/Cost:**	**70-80**
Lift Truck/Jammer	**Score:**	**22**	**Risk/Cost:**	**70-80**
Hydraulic Equipment	**Score:**	**18**	**Risk/Cost:**	**70-80**
Air Compressor	**Score:**	**18**	**Risk/Cost:**	**70-80**
General SE	**Score:**	**18**	**Risk/Cost:**	**70-80**
Ground Power/Start Cart	**Score:**	**10**	**Risk/Cost:**	**70-80**
Special Purpose Flightline	**Score:**	**8**	**Risk/Cost:**	**70-80**
Auxiliary Lighting	**Score:**	**6**	**Risk/Cost:**	**70-80**
		247		

346 Low Maintenance Battery System for Aircraft

Synopsis: This concept involves a low maintenance battery system in the size range of 1 to 50 ampere hours for uninterruptible power to flight controls, inertial platforms and aircraft main power. Service life should be 1,000 flighthours with a 3-year maintenance interval. This battery will eliminate the need for field maintenance battery shops through such features as self-test, self-monitoring, and rapid recharge capability to support autonomous operations and noninterruptible fault-tolerant aircraft power. The system will consist of three units; a sealed battery pack, a charger unit, and a monitor/control unit employing a microprocessor.

Source: AFCOLR, 1985 Logistics Research & Studies Program, pg. 4-28.

Potential Apps: Gel batteries are presently in use on the USAF flightline, but feedback indicates they have problems of their own. Cold weather cranking power is lacking in the new gels. New battery technology is needed to increase performance and battery life. At present, the business of supplying battery replacements for DoD agencies is a lucrative one. During 1995, the US Army alone spent $77.2 million on 300 different types of batteries.

Misc In-Shop Equipment	**Score:**	**121**	**Risk/Cost:**	**70-80**
Environmental	**Score:**	**26**	**Risk/Cost:**	**70-80**
Lift Truck/Jammer	**Score:**	**22**	**Risk/Cost:**	**70-80**
General SE	**Score:**	**18**	**Risk/Cost:**	**70-80**
Hydraulic Equipment	**Score:**	**18**	**Risk/Cost:**	**70-80**
Air Compressor	**Score:**	**18**	**Risk/Cost:**	**70-80**
Ground Power/Start Cart	**Score:**	**10**	**Risk/Cost:**	**70-80**
Special Purpose Flightline	**Score:**	**8**	**Risk/Cost:**	**70-80**
Auxiliary Lighting	**Score:**	**6**	**Risk/Cost:**	**70-80**
		247		

364 Two-Year Batteries for Aircraft

Synopsis: Reduced maintenance batteries will soon be available for in-service Boeing 737, 747, 757 and 767 transports. Eldec Corporation of Lynnwood, Washington, is working with several battery manufacturers to develop advanced nickel-cadmium main batteries and related inflight charging system modification kits. The new batteries will not need maintenance for at least two years, compared with every three months in current high-use transports. Although initially more expensive, the new battery system will reduce maintenance, handling and disposal problems. A future zero maintenance version will allow airlines to drop expensive battery overhaul shops.

Source: Aviation & Space Technology, 27 Sep 1993, pg. 17.

Potential Apps: The US Armed Forces have long recognized the need for better battery technologies. Ideally, a battery would be composed of non-toxic materials, be infinitely rechargeable with none of the weight, safety and environmental concerns associated with metal-based batteries. Gel batteries, in use today on the USAF flightline, have problems with cold weather cranking. At present, the business of supplying battery replacements for DoD agencies is a lucrative one. During 1995, the US Army alone spent $77.2 million on 300 different types of batteries.

Misc In-Shop Equipment	**Score:**	**121**	**Risk/Cost:**	**70-80**
Environmental	**Score:**	**26**	**Risk/Cost:**	**70-80**
Lift Truck/Jammer	**Score:**	**22**	**Risk/Cost:**	**70-80**
General SE	**Score:**	**18**	**Risk/Cost:**	**70-80**
Hydraulic Equipment	**Score:**	**18**	**Risk/Cost:**	**70-80**
Air Compressor	**Score:**	**18**	**Risk/Cost:**	**70-80**
Ground Power/Start Cart	**Score:**	**10**	**Risk/Cost:**	**70-80**

Special Purpose Flightline	**Score:**	**8**	**Risk/Cost:**	**70-80**
Auxiliary Lighting	**Score:**	**6**	**Risk/Cost:**	**70-80**
		247		

Technology Rating Summaries

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
1	212	Liquid Flow-Through Cooling for Power Supplies	Air Conditioner	276	90-95
2	247	High Temperature Electronics (Up to 535 Deg C)	Air Conditioner	276	90-95
3	279	High Performance Heat-Absorbing Material for Liquids or Solid Materials	Air Conditioner	276	90-95
4	282	Whisper Power Ground Power Unit From Hobart	Ground Power/Start Cart	276	10-15
5	360	Immersion Phase-Change Cooling for Aircraft	Air Conditioner	276	90-95
6	297	RAZ and miniRAZ Munitions Handling Trolleys	Lift Truck/Jammer	252	0-5
7	356	Multiple Integrated Power Unit (MIPU) For Aircraft	Ground Power/Start Cart	220	65-70
8	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	Ground Power/Start Cart	218	90-95
9	1	Multifunction Aircraft Ground Support System (MAGSS)	Ground Power/Start Cart	211	15-20
10	1	Multifunction Aircraft Ground Support System (MAGSS)	Hydraulic Equipment	209	25-30
11	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	Hydraulic Equipment	209	90-95
12	40	Rare-Earth Magnet Direct Drive Servovalves (DDV), Electrically Controlled	Lift Truck/Jammer	197	25-30
13	152	Electrohydrostatic Actuation (EHA) System for Primary Flight Controls	Lift Truck/Jammer	197	25-30
14	309	Electric Vehicles	Lift Truck/Jammer	195	40-45
15	356	Multiple Integrated Power Unit (MIPU) For Aircraft	Air Conditioner	190	65-70
16	176	Modular Aircraft Staging System - Maintenance Stands	Maintenance Stand	182	15-20
17	357	Integrated OBOGS / OBIGGS Module for Aircraft	Servicing	179	25-30
18	1	Multifunction Aircraft Ground Support System (MAGSS)	Auxiliary Lighting	171	0-5
19	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	Auxiliary Lighting	171	0-5
20	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	Air Compressor	168	90-95
21	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	Maintenance Stand	164	30-40
22	1	Multifunction Aircraft Ground Support System (MAGSS)	Air Compressor	160	20-25
23	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	Air Conditioner	159	90-95
24	300	Portable Environmental Control System (PECS) for Air Cooling & Heating	Air Conditioner	159	0-5
25	40	Rare-Earth Magnet Direct Drive Servovalves (DDV), Electrically Controlled	Cargo Handling	154	25-30
26	152	Electrohydrostatic Actuation (EHA) System for Primary Flight Controls	Cargo Handling	154	25-30
27	1	Multifunction Aircraft Ground Support System (MAGSS)	Air Conditioner	151	0-5
28	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	Maintenance Stand	148	30-40

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
29	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	Maintenance Stand	148	30-40
30	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	Maintenance Stand	148	30-40
31	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	Maintenance Stand	148	30-40
32	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	Maintenance Stand	148	30-40
33	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	Maintenance Stand	148	30-40
34	306	Composite Vehicle Structure	Maintenance Stand	148	30-40
35	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	Maintenance Stand	148	30-40
36	358	Thermoplastic Repairs By Bonding With Induction Heating	Maintenance Stand	148	30-40
37	22	Self-Generating Nitrogen Through Hollow Fiber Membrane Technology	Servicing	143	25-40
38	185	Carbon Foam Material for Insulation, High-Temp Filters and Engine Parts	Heater	133	50-55
39	262	Portable Computer Diagnostic System for F-16 Flightline Maintenance	Test Set	133	45-50
40	218	Maxi-Heat Portable Heater and Generator for Isolated Job Sites	Heater	128	15-20
41	27	Reduced Maintenance Batteries	Misc In-Shop Equipment	121	70-80
42	78	Lithium Solid Polymer Electrolyte Batteries	Misc In-Shop Equipment	121	70-80
43	133	All-Plastic Battery	Misc In-Shop Equipment	121	70-80
44	155	High Reliability Maintenance-Free Battery	Misc In-Shop Equipment	121	70-80
45	233	Solar Power to Extend Battery Life (Solargizers)	Misc In-Shop Equipment	121	15-20
46	238	All-Plastic, Solid State Battery	Misc In-Shop Equipment	121	70-80
47	346	Low Maintenance Battery System for Aircraft	Misc In-Shop Equipment	121	70-80
48	364	Two-Year Batteries for Aircraft	Misc In-Shop Equipment	121	70-80
49	1	Multifunction Aircraft Ground Support System (MAGSS)	General SE	108	20-25
50	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	General SE	106	90-95
51	243	Computerized System to Track Limited-Life, On-Condition Components	Air Conditioner	104	15-20
52	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	Air Compressor	102	30-40
53	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	Air Compressor	102	30-40
54	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	Air Compressor	102	30-40
55	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	Air Compressor	102	30-40
56	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	Air Compressor	102	30-40
57	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	Air Compressor	102	30-40
58	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	Air Compressor	102	30-40
59	306	Composite Vehicle Structure	Air Compressor	102	30-40

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
60	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	Air Compressor	102	30-40
61	358	Thermoplastic Repairs By Bonding With Induction Heating	Air Compressor	102	30-40
62	243	Computerized System to Track Limited-Life, On-Condition Components	Ground Power/Start Cart	100	15-20
63	235	Focused Logistics (Joint Vision 2010)	General SE	88	50-55
64	237	Joint Computer Aided Acquisition and Logistics System (JCALS)	General SE	88	50-55
65	255	New European Pallet/Container Loader (31K) for Commercial Transporters	Cargo Handling	84	25-30
66	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	Jack	75	50-60
67	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	Gun/Loading	73	50-60
68	299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical	Air Compressor	71	10-15
69	4	Warrior Vision	General SE	67	65-70
70	7	Integrated Maintenance Information System	General SE	67	65-70
71	124	Thin Film Coating may Reduce the Need for Lubricants	Gun/Loading	65	40-45
72	316	Flow-Through Ion Gun	Gun/Loading	65	50-55
73	21	U-Shaped Tow Vehicle	Towbar	64	25-30
74	21	U-Shaped Tow Vehicle	Tow Vehicle/Truck	64	25-30
75	223	Douglas-Kalmer TBL-280 Towbarless Aircraft Tug	Towbar	64	25-30
76	223	Douglas-Kalmer TBL-280 Towbarless Aircraft Tug	Tow Vehicle/Truck	64	25-30
77	243	Computerized System to Track Limited-Life, On-Condition Components	Auxiliary Lighting	64	15-20
78	294	Electrically-Powered Aircraft Towing Mechanism	Towbar	64	25-30
79	344	Integral Variable Displacement (IVD) Fuel Tank for Aircraft	General SE	64	60-65
80	299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical	Hydraulic Equipment	63	10-15
81	6	Automated Tech Order System	General SE	62	0-5
82	83	UK Royal Navy Computerized Illustrated Parts Catalog for Naval Vessels	General SE	62	0-5
83	204	Computer-Based Technical Manuals	General SE	62	0-5
84	301	New Non-Volatile Parts Cleaner Developed By McDonnell Douglas Corp	Environmental	62	25-30
85	301	New Non-Volatile Parts Cleaner Developed By McDonnell Douglas Corp	General SE	62	25-30
86	17	Modular Tow Tractor	Tow Vehicle/Truck	60	25-30
87	294	Electrically-Powered Aircraft Towing Mechanism	Tow Vehicle/Truck	60	25-30
88	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	Auxiliary Lighting	59	50-60
89	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Ground Power/Start Cart	58	0-5
90	334	Oil-Resistant Silicone	Ground Power/Start Cart	58	0-5
91	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	Ground Power/Start Cart	57	30-40

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
92	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	Ground Power/Start Cart	57	30-40
93	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	Ground Power/Start Cart	57	30-40
94	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	Ground Power/Start Cart	57	30-40
95	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	Ground Power/Start Cart	57	30-40
96	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	Ground Power/Start Cart	57	30-40
97	210	Streamlined Smart Procurement System by Intelligent Agent Software	General SE	57	20-30
98	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	Ground Power/Start Cart	57	30-40
99	302	Split-Cycle Technology Engine	Ground Power/Start Cart	57	90-95
100	306	Composite Vehicle Structure	Ground Power/Start Cart	57	30-40
101	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	Ground Power/Start Cart	57	30-40
102	358	Thermoplastic Repairs By Bonding With Induction Heating	Ground Power/Start Cart	57	30-40
103	136	High Efficiency Propulsion System	Air Compressor	53	75-80
104	302	Split-Cycle Technology Engine	Air Compressor	53	75-80
105	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	Air Conditioner	51	30-40
106	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	Air Conditioner	51	30-40
107	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	Air Conditioner	51	30-40
108	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	Air Conditioner	51	30-40
109	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	Air Conditioner	51	30-40
110	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	Air Conditioner	51	30-40
111	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	Air Conditioner	51	30-40
112	306	Composite Vehicle Structure	Air Conditioner	51	30-40
113	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	Air Conditioner	51	30-40
114	358	Thermoplastic Repairs By Bonding With Induction Heating	Air Conditioner	51	30-40
115	67	Australian DoD Aircraft Maintenance Management Computer System	CAMS	50	0-0
116	136	High Efficiency Propulsion System	Ground Power/Start Cart	50	75-80
117	340	Gold DotTM Technology for Oxide-Free Electrical Contacts	Test Set	50	50-55
118	236	A Personal Computer Worn on the Body with Hands-Free Operation	General SE	49	45-55
119	302	Split-Cycle Technology Engine	Special Purpose Flightline	49	90-95
120	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	Air Compressor	48	50-60
121	224	Windows-Based Maintenance Budgeting Software	General SE	48	5-10
122	243	Computerized System to Track Limited-Life, On-Condition Components	Cargo Handling	48	15-20

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
123	87	Trapeze Launcher Actuator Assembly for the F-22 Next Generation Fighter	Lift Truck/Jammer	46	40-45
124	309	Electric Vehicles	Tow Vehicle/Truck	46	40-45
125	330	Circuit Breaker Switch Panels	Lift Truck/Jammer	46	0-5
126	353	Built-In Cable Load Boxes/Drums for Aircraft	Lift Truck/Jammer	46	40-45
127	34	Hybrid Gas/Powder Fire Extinguishing Agent (Halon-Free)	Special Purpose Flightline	45	0-5
128	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Jack	45	0-5
129	307	Composite Gears	Gun/Loading	45	15-20
130	334	Oil-Resistant Silicone	Jack	45	0-5
131	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	Lift Truck/Jammer	44	50-60
132	302	Split-Cycle Technology Engine	Auxiliary Lighting	44	90-95
133	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	Towbar	43	50-60
134	216	Self-Sealing Fasteners for Anti-Leak Requirements	Ground Power/Start Cart	43	0-5
135	292	The Jetpower PMW 400 Hz Converter	Ground Power/Start Cart	42	40-45
136	16	Mercury 800 Tow Tractor	Tow Vehicle/Truck	41	15-20
137	136	High Efficiency Propulsion System	Special Purpose Flightline	41	75-80
138	172	Shift Shock Stop - Transmission Protection Device	Tow Vehicle/Truck	41	15-20
139	338	Hobbs Electronic FNR Shifter for Off-Road Equipment	Tow Vehicle/Truck	41	15-20
140	297	RAZ and miniRAZ Munitions Handling Trolleys	General SE	40	0-5
141	339	Pulsed Power to Reduce Nitrogen Oxide Emissions from Diesel Engines	General SE	40	25-30
142	34	Hybrid Gas/Powder Fire Extinguishing Agent (Halon-Free)	Ground Power/Start Cart	39	0-5
143	34	Hybrid Gas/Powder Fire Extinguishing Agent (Halon-Free)	Air Compressor	39	0-5
144	175	Battery Checker and Log Device	Misc In-Shop Equipment	39	15-20
145	41	High Pressure Miniature Hydraulic Pumps (Fixed or Variable)	Lift Truck/Jammer	37	40-45
146	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	Maintenance Stand	37	50-60
147	201	Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches	Air Compressor	37	0-5
148	277	Rapid Database Builder For Text, Graphics and Photographs	General SE	37	15-20
149	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Trailer/Dolly	37	0-5
150	334	Oil-Resistant Silicone	Trailer/Dolly	37	0-5
151	136	High Efficiency Propulsion System	Auxiliary Lighting	36	75-80
152	10	Reconfigurable Ground Support Frame	Trailer/Dolly	35	25-30
153	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	Ground Power/Start Cart	35	50-60
154	136	High Efficiency Propulsion System	Hydraulic Equipment	35	75-80
155	302	Split-Cycle Technology Engine	Hydraulic Equipment	35	75-80
156	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	Auxiliary Lighting	34	15-20
157	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Maintenance Stand	34	0-5

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
158	322	MagneStrap	Auxiliary Lighting	34	15-20
159	334	Oil-Resistant Silicone	Maintenance Stand	34	0-5
160	50	Portable Bar Code Printer for Warehouse Pallets (K2000)	General SE	33	0-5
161	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Auxiliary Lighting	32	0-5
162	334	Oil-Resistant Silicone	Auxiliary Lighting	32	0-5
163	173	Advanced Graphical Multimeter	Test Set	31	15-20
164	1	Multifunction Aircraft Ground Support System (MAGSS)	Deployment	30	20-25
165	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	General SE	30	30-40
166	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	General SE	30	30-40
167	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	General SE	30	30-40
168	57	USMC Mobile Fuel Filtration Trailer	General SE	30	25-30
169	58	SwRI's Smart Beacon Package to Locate Anything, Anywhere	General SE	30	50-55
170	62	Savi Asset Management and Transportation Management System	General SE	30	50-55
171	180	Wristwatch-Size GPS Receivers for Embedded Applications	General SE	30	50-55
172	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	General SE	30	30-40
173	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	General SE	30	30-40
174	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	General SE	30	30-40
175	234	Asset Visibility - Improved Automated Logistics Tracking Systems	General SE	30	50-55
176	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	General SE	30	30-40
177	288	Combat Track - Satellite Linked Logistics Tracking System	General SE	30	50-55
178	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	Deployment	30	90-95
179	306	Composite Vehicle Structure	General SE	30	30-40
180	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	General SE	30	30-40
181	358	Thermoplastic Repairs By Bonding With Induction Heating	General SE	30	30-40
182	330	Circuit Breaker Switch Panels	Air Compressor	29	0-5
183	13	CBR Facility for Decontamination, Deicing and Refueling	General SE	28	75-80
184	231	Electron-Beam Curing Process for Composite Parts	General SE	28	40-45
185	243	Computerized System to Track Limited-Life, On-Condition Components	Heater	28	15-20
186	34	Hybrid Gas/Powder Fire Extinguishing Agent (Halon-Free)	Heater	27	0-5
187	172	Shift Shock Stop - Transmission Protection Device	Lift Truck/Jammer	27	15-20
188	338	Hobbs Electronic FNR Shifter for Off-Road Equipment	Lift Truck/Jammer	27	15-20

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
189	27	Reduced Maintenance Batteries	Environmental	26	70-80
190	38	Microprocessor Engine Control System with Engine Parameter Sensing	General SE	26	10-15
191	78	Lithium Solid Polymer Electrolyte Batteries	Environmental	26	70-80
192	133	All-Plastic Battery	Environmental	26	70-80
193	155	High Reliability Maintenance-Free Battery	Environmental	26	70-80
194	233	Solar Power to Extend Battery Life (Solargizers)	Environmental	26	15-20
195	238	All-Plastic, Solid State Battery	Environmental	26	70-80
196	346	Low Maintenance Battery System for Aircraft	Environmental	26	70-80
197	364	Two-Year Batteries for Aircraft	Environmental	26	70-80
198	141	"Floating" Auto-Retract Axle Jack	Jack	25	5-15
199	1	Multifunction Aircraft Ground Support System (MAGSS)	Servicing	24	0-5
200	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	Deployment	24	30-35
201	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	Deployment	24	30-35
202	53	Viscous Resin Thread-Locking Compound (Vibra-Tite)	General SE	24	0-5
203	123	Polyester Material for Fasteners	General SE	24	0-5
204	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	Air Compressor	24	15-20
205	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	Deployment	24	30-35
206	191	Advanced Self-Locking Fastener With Reusable Nut Sleeve & Lock Ring	General SE	24	0-5
207	192	Omni-Lok Self-Locking Fastener for High-Temperature Applications	General SE	24	0-5
208	195	DUAL-LOK Self-Locking Fastener for High-Temperature Applications	General SE	24	0-5
209	216	Self-Sealing Fasteners for Anti-Leak Requirements	Special Purpose Flightline	24	0-5
210	221	Interactive Spare Parts Ordering Via Internet	General SE	24	30-40
211	272	Avionics Reliability Evaluation Corrective Action Program (RECAP)	General SE	24	0-0
212	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	Deployment	24	30-40
213	283	Self-Locking All-Metal Fastener	General SE	24	0-5
214	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Air Compressor	24	0-5
215	293	Head-To-Toe Soldier Protective Ensemble	Environmental	24	40-45
216	302	Split-Cycle Technology Engine	Tow Vehicle/Truck	24	90-95
217	306	Composite Vehicle Structure	Deployment	24	30-35
218	322	MagneStrap	Air Compressor	24	15-20
219	334	Oil-Resistant Silicone	Air Compressor	24	0-5
220	5	Automated Jacking	Jack	22	60-65
221	27	Reduced Maintenance Batteries	Lift Truck/Jammer	22	70-80
222	78	Lithium Solid Polymer Electrolyte Batteries	Lift Truck/Jammer	22	70-80
223	133	All-Plastic Battery	Lift Truck/Jammer	22	70-80
224	155	High Reliability Maintenance-Free Battery	Lift Truck/Jammer	22	70-80
225	233	Solar Power to Extend Battery Life (Solargizers)	Lift Truck/Jammer	22	15-20

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
226	238	All-Plastic, Solid State Battery	Lift Truck/Jammer	22	70-80
227	261	Tri-Color Bargraph System for LED Instruments	Ground Power/Start Cart	22	15-20
228	330	Circuit Breaker Switch Panels	Ground Power/Start Cart	22	0-5
229	346	Low Maintenance Battery System for Aircraft	Lift Truck/Jammer	22	70-80
230	364	Two-Year Batteries for Aircraft	Lift Truck/Jammer	22	70-80
231	27	Reduced Maintenance Batteries	Auxiliary Lighting	21	70-80
232	31	High-Purity Ceramics for High-Temp Strength and Corrosion Resistance	Heater	21	50-55
233	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	Hydraulic Equipment	21	30-40
234	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	Hydraulic Equipment	21	30-40
235	58	SwRI's Smart Beacon Package to Locate Anything, Anywhere	Deployment	21	50-55
236	62	Savi Asset Management and Transportation Management System	Deployment	21	50-55
237	93	Polyurethane Topcoats for Aircraft and Support Equipment	Air Conditioner	21	0-5
238	98	Diffusional Coatings For Flight Hardware And Ground Support Equipment	Air Conditioner	21	50-55
239	99	A Low Profile Cryogenic SCBA System With Personal Cooling And Whole-Body Protective Suit	Environmental	21	40-45
240	180	Wristwatch-Size GPS Receivers for Embedded Applications	Deployment	21	50-55
241	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	Hydraulic Equipment	21	30-40
242	196	Tough Engineering Plastic Resins for Corrosion-Resistant Coatings	Air Conditioner	21	0-5
243	206	Interactive Desktop Computer Training Techniques	General SE	21	0-5
244	209	Virtual Classrooms Via Personal Computer Terminals	General SE	21	10-15
245	216	Self-Sealing Fasteners for Anti-Leak Requirements	Hydraulic Equipment	21	0-5
246	234	Asset Visibility - Improved Automated Logistics Tracking Systems	Deployment	21	50-55
247	241	Glass-Epoxy-Aluminum Composite for Bonded Repairs	Air Compressor	21	25-30
248	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	Hydraulic Equipment	21	30-40
249	288	Combat Track - Satellite Linked Logistics Tracking System	Deployment	21	50-55
250	306	Composite Vehicle Structure	Hydraulic Equipment	21	30-40
251	316	Flow-Through Ion Gun	Air Conditioner	21	50-55
252	330	Circuit Breaker Switch Panels	Misc In-Shop Equipment	21	0-5
253	26	Ice Blast	Environmental	20	15-20
254	28	Carbon Dioxide Pellet Cleaning System	Environmental	20	15-20
255	51	Non-Toxic Flashjet Coatings Removal Process for Aircraft	Environmental	20	15-20
256	74	UK Contracts to Study Equipment Cost and Operation Implications	General SE	20	25-30

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
257	81	UK Army Ground Equipment Assessment and Support Database Program	General SE	20	25-30
258	85	Advanced Cost Modeling Tools for JAST Design Assessments	General SE	20	25-30
259	107	A Non-Polluting Electrochemical Paint Stripping Technology	Environmental	20	50-55
260	122	Automatic Engine Stop/Start System	General SE	20	25-30
261	176	Modular Aircraft Staging System - Maintenance Stands	Deployment	20	15-20
262	199	Zinc-Based Alloy Films for Highly Corrosion-Resistant Protection	Environmental	20	40-45
263	313	Generic Electronics Module	General SE	20	25-30
264	136	High Efficiency Propulsion System	Tow Vehicle/Truck	19	75-80
265	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	Ground Power/Start Cart	19	15-20
266	322	MagneStrap	Ground Power/Start Cart	19	15-20
267	330	Circuit Breaker Switch Panels	General SE	19	0-5
268	27	Reduced Maintenance Batteries	Air Compressor	18	70-80
269	27	Reduced Maintenance Batteries	General SE	18	70-80
270	27	Reduced Maintenance Batteries	Hydraulic Equipment	18	70-80
271	29	Oil Analysis Spectrometer	General SE	18	0-5
272	33	Thermostatically-Controlled Resistive Heaters	General SE	18	0-5
273	33	Thermostatically-Controlled Resistive Heaters	Ground Power/Start Cart	18	0-5
274	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	Lift Truck/Jammer	18	30-40
275	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	Lift Truck/Jammer	18	30-40
276	52	Long-Term, Salt Water-Displacing Corrosion Inhibitor for Aircraft	Air Conditioner	18	0-5
277	78	Lithium Solid Polymer Electrolyte Batteries	General SE	18	70-80
278	78	Lithium Solid Polymer Electrolyte Batteries	Hydraulic Equipment	18	70-80
279	78	Lithium Solid Polymer Electrolyte Batteries	Air Compressor	18	70-80
280	86	Active Noise Reduction (ANR) Headsets for Armored Vehicle Operators	General SE	18	15-20
281	96	Noise Canceling Headsets (HMEC45-45KA/CA)	General SE	18	15-20
282	133	All-Plastic Battery	Air Compressor	18	70-80
283	133	All-Plastic Battery	Hydraulic Equipment	18	70-80
284	133	All-Plastic Battery	General SE	18	70-80
285	155	High Reliability Maintenance-Free Battery	Hydraulic Equipment	18	70-80
286	155	High Reliability Maintenance-Free Battery	General SE	18	70-80
287	155	High Reliability Maintenance-Free Battery	Air Compressor	18	70-80
288	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	Lift Truck/Jammer	18	30-40
289	201	Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches	Auxiliary Lighting	18	0-5
290	233	Solar Power to Extend Battery Life (Solargizers)	Hydraulic Equipment	18	15-20
291	233	Solar Power to Extend Battery Life (Solargizers)	Air Compressor	18	15-20
292	233	Solar Power to Extend Battery Life (Solargizers)	General SE	18	15-20
293	238	All-Plastic, Solid State Battery	Air Compressor	18	70-80

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
294	238	All-Plastic, Solid State Battery	General SE	18	70-80
295	238	All-Plastic, Solid State Battery	Hydraulic Equipment	18	70-80
296	253	Electrically Heated Fluid Reservoir Heater	Ground Power/Start Cart	18	0-5
297	253	Electrically Heated Fluid Reservoir Heater	General SE	18	0-5
298	306	Composite Vehicle Structure	Lift Truck/Jammer	18	30-40
299	346	Low Maintenance Battery System for Aircraft	Air Compressor	18	70-80
300	346	Low Maintenance Battery System for Aircraft	General SE	18	70-80
301	346	Low Maintenance Battery System for Aircraft	Hydraulic Equipment	18	70-80
302	364	Two-Year Batteries for Aircraft	General SE	18	70-80
303	364	Two-Year Batteries for Aircraft	Air Compressor	18	70-80
304	364	Two-Year Batteries for Aircraft	Hydraulic Equipment	18	70-80
305	3	Expert Decision Support Software to Speed Maintenance	General SE	17	10-15
306	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	Auxiliary Lighting	17	30-40
307	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	Hydraulic Equipment	17	30-40
308	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	Auxiliary Lighting	17	30-40
309	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	Auxiliary Lighting	17	30-40
310	164	Virtual Maintainer' Speeds Flightline Troubleshooting	General SE	17	10-15
311	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	Auxiliary Lighting	17	30-40
312	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	Auxiliary Lighting	17	30-40
313	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	Hydraulic Equipment	17	30-40
314	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	Hydraulic Equipment	17	30-40
315	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	Auxiliary Lighting	17	30-40
316	216	Self-Sealing Fasteners for Anti-Leak Requirements	General SE	17	0-5
317	220	DoD Acquisition of Commercial-Type Cargo Containers for CRAF Aircraft	Deployment	17	25-30
318	226	New Thermoplastic Composite Cargolite for Cargo Containers	Deployment	17	30-40
319	265	Expanded Capability for the Portable Flightline Tester for Commercial Acft	General SE	17	10-15
320	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	Auxiliary Lighting	17	30-40
321	306	Composite Vehicle Structure	Auxiliary Lighting	17	30-40
322	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	Hydraulic Equipment	17	30-40
323	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	Auxiliary Lighting	17	30-40
324	358	Thermoplastic Repairs By Bonding With Induction Heating	Auxiliary Lighting	17	30-40
325	358	Thermoplastic Repairs By Bonding With Induction Heating	Hydraulic Equipment	17	30-40
326	33	Thermostatically-Controlled Resistive Heaters	Air Compressor	16	0-5
327	33	Thermostatically-Controlled Resistive Heaters	Heater	16	0-5

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
328	33	Thermostatically-Controlled Resistive Heaters	Lift Truck/Jammer	16	0-5
329	129	A Single Gauge Versus an Instrument Cluster	Hydraulic Equipment	16	20-25
330	129	A Single Gauge Versus an Instrument Cluster	Servicing	16	20-25
331	221	Interactive Spare Parts Ordering Via Internet	CAMS	16	30-40
332	227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	Air Conditioner	16	0-5
333	251	Microwave Reflectometer for Fltline Inspections of LO Material Reflectivity	General SE	16	45-50
334	253	Electrically Heated Fluid Reservoir Heater	Heater	16	0-5
335	253	Electrically Heated Fluid Reservoir Heater	Air Compressor	16	0-5
336	253	Electrically Heated Fluid Reservoir Heater	Lift Truck/Jammer	16	0-5
337	278	Patented Surface Hardening Process (Nobleizing) for Valves	General SE	16	15-20
338	38	Microprocessor Engine Control System with Engine Parameter Sensing	Air Compressor	15	10-15
339	39	Fully-Electronic AWG and Power Cable Cutter/Stripper/Processor	General SE	15	40-45
340	46	Laminated Heat Spreaders for IC Devices (T-Wing)	Ground Power/Start Cart	15	0-5
341	47	SpiderClip Heat Sinks for IC Devices (No Adhesives)	Ground Power/Start Cart	15	0-5
342	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	Tow Vehicle/Truck	15	15-20
343	184	Air Transportable Cargo Loader for Forward Location Self-Sufficiency	General SE	15	25-30
344	187	Diamond-Coated Ceramic Ball Bearings	Ground Power/Start Cart	15	15-20
345	196	Tough Engineering Plastic Resins for Corrosion-Resistant Coatings	Maintenance Stand	15	0-5
346	201	Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches	Test Set	15	0-5
347	216	Self-Sealing Fasteners for Anti-Leak Requirements	Test Set	15	0-5
348	250	Self-Locking Heat Sink for Surface Mounted Components	Ground Power/Start Cart	15	0-5
349	254	Heat Shrink Bar Code Labels on Identification Sleeves	Lift Truck/Jammer	15	0-5
350	261	Tri-Color Bargraph System for LED Instruments	Special Purpose Flightline	15	15-20
351	271	Aircraft Tire Leasing for Reduced Inventory and Recycling Benefits	Lift Truck/Jammer	15	0-5
352	322	MagneStrap	Tow Vehicle/Truck	15	15-20
353	343	Integral Strut Jack for Aircraft	Jack	15	50-55
354	93	Polyurethane Topcoats for Aircraft and Support Equipment	Maintenance Stand	14	0-5
355	98	Diffusional Coatings For Flight Hardware And Ground Support Equipment	Maintenance Stand	14	50-55
356	114	New Auto Paint Cuts Solvent Emissions	Environmental	14	0-5
357	121	Stove-top Generator Lights Arctic Nights	Ground Power/Start Cart	14	0-0
358	139	Universal Data Logger	General SE	14	20-25
359	160	New Device Removes Deadly Carbon Monoxide	Heater	14	50-55
360	201	Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches	Lift Truck/Jammer	14	0-5

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
361	203	Aero-Casters for Air Cushioned Movement of Personnel Lifts	Maintenance Stand	14	20-25
362	259	Portable Flightline Lighting System Using Optical Fiber Cables	General SE	14	15-20
363	316	Flow-Through Ion Gun	Maintenance Stand	14	50-55
364	52	Long-Term, Salt Water-Displacing Corrosion Inhibitor for Aircraft	Maintenance Stand	13	0-5
365	93	Polyurethane Topcoats for Aircraft and Support Equipment	General SE	13	0-5
366	98	Diffusional Coatings For Flight Hardware And Ground Support Equipment	General SE	13	50-55
367	196	Tough Engineering Plastic Resins for Corrosion-Resistant Coatings	General SE	13	0-5
368	216	Self-Sealing Fasteners for Anti-Leak Requirements	Deployment	13	0-5
369	316	Flow-Through Ion Gun	General SE	13	50-55
370	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	Lift Truck/Jammer	12	30-40
371	42	Pressure-Reducing Regulator with Bubble-Tight Sealing (Gas or Liquid)	Servicing	12	15-20
372	50	Portable Bar Code Printer for Warehouse Pallets (K2000)	Deployment	12	0-5
373	185	Carbon Foam Material for Insulation, High-Temp Filters and Engine Parts	Air Compressor	12	75-80
374	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	Lift Truck/Jammer	12	30-40
375	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	Lift Truck/Jammer	12	30-40
376	216	Self-Sealing Fasteners for Anti-Leak Requirements	Tow Vehicle/Truck	12	0-5
377	258	Emergency Containment and Recovery System for Toxic Fluid Spills	Environmental	12	40-45
378	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	Lift Truck/Jammer	12	30-40
379	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Heater	12	0-5
380	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Lift Truck/Jammer	12	0-5
381	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Hydraulic Equipment	12	0-5
382	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Tow Vehicle/Truck	12	0-5
383	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Cargo Handling	12	0-5
384	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Aircraft Deicer/Washer	12	0-5
385	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	Air Conditioner	12	0-5
386	334	Oil-Resistant Silicone	Hydraulic Equipment	12	0-5
387	334	Oil-Resistant Silicone	Lift Truck/Jammer	12	0-5
388	334	Oil-Resistant Silicone	Heater	12	0-5
389	334	Oil-Resistant Silicone	Air Conditioner	12	0-5
390	334	Oil-Resistant Silicone	Aircraft Deicer/Washer	12	0-5
391	334	Oil-Resistant Silicone	Cargo Handling	12	0-5

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
392	334	Oil-Resistant Silicone	Tow Vehicle/Truck	12	0-5
393	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	Lift Truck/Jammer	12	30-40
394	356	Multiple Integrated Power Unit (MIPU) For Aircraft	Deployment	12	65-70
395	358	Thermoplastic Repairs By Bonding With Induction Heating	Lift Truck/Jammer	12	30-40
396	26	Ice Blast	Misc In-Shop Equipment	11	15-20
397	28	Carbon Dioxide Pellet Cleaning System	Misc In-Shop Equipment	11	15-20
398	51	Non-Toxic Flashjet Coatings Removal Process for Aircraft	Misc In-Shop Equipment	11	20-25
399	59	Contractor Refurbishment of RAAF Ground Support Equipment	General SE	11	0-5
400	66	UK RAF Air Data Test Sets with Contractor Support	Test Set	11	0-5
401	73	Australian Contractor Support for Calibration & Repair of RAAF Test Sets	Test Set	11	0-5
402	203	Aero-Casters for Air Cushioned Movement of Personnel Lifts	Jack	11	20-25
403	245	Comprehensive Integrated Mechanical Diagnostics System	Ground Power/Start Cart	11	25-30
404	336	Vibration Meter	Ground Power/Start Cart	11	25-30
405	14	Transportable Missile Storage Racks	Trailer/Dolly	10	15-20
406	27	Reduced Maintenance Batteries	Ground Power/Start Cart	10	70-80
407	31	High-Purity Ceramics for High-Temp Strength and Corrosion Resistance	Ground Power/Start Cart	10	50-55
408	37	Piezoresistive Shock and Vibration Data Recorder	Ground Power/Start Cart	10	15-20
409	52	Long-Term, Salt Water-Displacing Corrosion Inhibitor for Aircraft	General SE	10	0-5
410	78	Lithium Solid Polymer Electrolyte Batteries	Ground Power/Start Cart	10	70-80
411	133	All-Plastic Battery	Ground Power/Start Cart	10	70-80
412	142	"Clean & Silent" Diesel Engines	General SE	10	15-20
413	155	High Reliability Maintenance-Free Battery	Ground Power/Start Cart	10	70-80
414	233	Solar Power to Extend Battery Life (Solargizers)	Ground Power/Start Cart	10	15-20
415	238	All-Plastic, Solid State Battery	Ground Power/Start Cart	10	70-80
416	261	Tri-Color Bargraph System for LED Instruments	Hydraulic Equipment	10	15-20
417	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	Servicing	10	90-95
418	346	Low Maintenance Battery System for Aircraft	Ground Power/Start Cart	10	70-80
419	364	Two-Year Batteries for Aircraft	Ground Power/Start Cart	10	70-80
420	10	Reconfigurable Ground Support Frame	Deployment	9	25-30
421	38	Microprocessor Engine Control System with Engine Parameter Sensing	Hydraulic Equipment	9	10-15
422	95	Self-Cooling Waterjet Cutting for Aircraft Sheet Metals and Composites	Air Conditioner	9	65-70
423	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	Aircraft Deicer/Washer	9	15-20
424	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	Cargo Handling	9	15-20
425	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	Air Conditioner	9	15-20

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
426	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	Lift Truck/Jammer	9	15-20
427	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	Special Purpose Flightline	9	15-20
428	222	In-Flight Location of Transports/Tankers and Crew & Cargo Status	Deployment	9	25-30
429	322	MagneStrap	Aircraft Deicer/Washer	9	15-20
430	322	MagneStrap	Cargo Handling	9	15-20
431	322	MagneStrap	Special Purpose Flightline	9	15-20
432	322	MagneStrap	Lift Truck/Jammer	9	15-20
433	322	MagneStrap	Air Conditioner	9	15-20
434	27	Reduced Maintenance Batteries	Special Purpose Flightline	8	70-80
435	38	Microprocessor Engine Control System with Engine Parameter Sensing	Tow Vehicle/Truck	8	10-15
436	78	Lithium Solid Polymer Electrolyte Batteries	Special Purpose Flightline	8	70-80
437	129	A Single Gauge Versus an Instrument Cluster	Ground Power/Start Cart	8	20-25
438	133	All-Plastic Battery	Special Purpose Flightline	8	70-80
439	139	Universal Data Logger	CAMS	8	20-25
440	155	High Reliability Maintenance-Free Battery	Special Purpose Flightline	8	70-80
441	227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	Ground Power/Start Cart	8	0-5
442	233	Solar Power to Extend Battery Life (Solargizers)	Special Purpose Flightline	8	15-20
443	238	All-Plastic, Solid State Battery	Special Purpose Flightline	8	70-80
444	261	Tri-Color Bargraph System for LED Instruments	General SE	8	15-20
445	286	High Density Gasket Materials	General SE	8	0-5
446	320	Composite Wrapped Gaskets	Ground Power/Start Cart	8	25-30
447	346	Low Maintenance Battery System for Aircraft	Special Purpose Flightline	8	70-80
448	364	Two-Year Batteries for Aircraft	Special Purpose Flightline	8	70-80
449	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	General SE	7	15-20
450	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	Heater	7	15-20
451	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	Hydraulic Equipment	7	15-20
452	185	Carbon Foam Material for Insulation, High-Temp Filters and Engine Parts	Lift Truck/Jammer	7	75-80
453	302	Split-Cycle Technology Engine	Air Conditioner	7	90-95
454	309	Electric Vehicles	Environmental	7	40-45
455	317	Lighter Cast-Iron Engine Blocks	Auxiliary Lighting	7	35-40
456	322	MagneStrap	Hydraulic Equipment	7	15-20
457	322	MagneStrap	General SE	7	15-20
458	322	MagneStrap	Heater	7	15-20
459	330	Circuit Breaker Switch Panels	Air Conditioner	7	0-5
460	330	Circuit Breaker Switch Panels	Auxiliary Lighting	7	0-5
461	330	Circuit Breaker Switch Panels	Cargo Handling	7	0-5
462	330	Circuit Breaker Switch Panels	Test Set	7	0-5
463	330	Circuit Breaker Switch Panels	Hydraulic Equipment	7	0-5
464	330	Circuit Breaker Switch Panels	Tow Vehicle/Truck	7	0-5
465	19	Clamshelter	Deployment	6	25-30

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
466	64	Relocatable, Expandable Shelters for US Army Aviation Maintenance	Deployment	6	25-30
467	78	Lithium Solid Polymer Electrolyte Batteries	Auxiliary Lighting	6	70-80
468	86	Active Noise Reduction (ANR) Headsets for Armored Vehicle Operators	Environmental	6	15-20
469	86	Active Noise Reduction (ANR) Headsets for Armored Vehicle Operators	Ground Power/Start Cart	6	15-20
470	96	Noise Canceling Headsets (HMEC45-45KA/CA)	Ground Power/Start Cart	6	15-20
471	96	Noise Canceling Headsets (HMEC45-45KA/CA)	Environmental	6	15-20
472	97	Bumpy Bar Codes for Aircraft Tires	Lift Truck/Jammer	6	15-20
473	129	A Single Gauge Versus an Instrument Cluster	Auxiliary Lighting	6	20-25
474	129	A Single Gauge Versus an Instrument Cluster	Lift Truck/Jammer	6	20-25
475	129	A Single Gauge Versus an Instrument Cluster	Special Purpose Flightline	6	20-25
476	129	A Single Gauge Versus an Instrument Cluster	Tow Vehicle/Truck	6	20-25
477	129	A Single Gauge Versus an Instrument Cluster	Cargo Handling	6	20-25
478	129	A Single Gauge Versus an Instrument Cluster	Air Conditioner	6	20-25
479	133	All-Plastic Battery	Auxiliary Lighting	6	70-80
480	155	High Reliability Maintenance-Free Battery	Auxiliary Lighting	6	70-80
481	158	Super Lightweight Fuel Tank	Ground Power/Start Cart	6	50-55
482	190	French-Made, Reusable, Collapsible Shipping Containers	Deployment	6	0-5
483	212	Liquid Flow-Through Cooling for Power Supplies	Deployment	6	90-95
484	233	Solar Power to Extend Battery Life (Solargizers)	Auxiliary Lighting	6	15-20
485	238	All-Plastic, Solid State Battery	Auxiliary Lighting	6	70-80
486	247	High Temperature Electronics (Up to 535 Deg C)	Deployment	6	90-95
487	264	The Rubb Rapid Erect Building for Flightline Maintenance/Storage	Deployment	6	25-30
488	274	Smart Material Compensator Rings for Turbine Engines	Ground Power/Start Cart	6	75-80
489	275	Active, Predictive Blade Tip Clearance System for Turbine Engines	Ground Power/Start Cart	6	75-80
490	279	High Performance Heat-Absorbing Material for Liquids or Solid Materials	Deployment	6	90-95
491	309	Electric Vehicles	Deployment	6	40-45
492	310	Miniature Power Relays	Misc In-Shop Equipment	6	5-10
493	317	Lighter Cast-Iron Engine Blocks	Air Compressor	6	35-40
494	341	Stressed Arch Hangars for Rapid, 100-Ft High Clear-Span Construction	Deployment	6	25-30
495	346	Low Maintenance Battery System for Aircraft	Auxiliary Lighting	6	70-80
496	360	Immersion Phase-Change Cooling for Aircraft	Deployment	6	90-95
497	364	Two-Year Batteries for Aircraft	Auxiliary Lighting	6	70-80
498	366	Hierarchical Diagnostic System (HDS) for Aircraft	Test Set	6	40-45
499	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	Tow Vehicle/Truck	5	30-40
500	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	Tow Vehicle/Truck	5	30-40
501	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	Tow Vehicle/Truck	5	30-40
502	125	Calibrated Bolt Indicated Tension	Tools	5	15-20

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
503	125	Calibrated Bolt Indicated Tension	General SE	5	15-20
504	136	High Efficiency Propulsion System	Air Conditioner	5	75-80
505	183	Scandinavian Bellyloader - Sliding Carpet Cargo Loading System	Deployment	5	15-20
506	183	Scandinavian Bellyloader - Sliding Carpet Cargo Loading System	General SE	5	15-20
507	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	Tow Vehicle/Truck	5	30-40
508	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	Tow Vehicle/Truck	5	30-40
509	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	Tow Vehicle/Truck	5	30-40
510	227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	Lift Truck/Jammer	5	0-5
511	227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	Air Compressor	5	0-5
512	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	Tow Vehicle/Truck	5	30-40
513	306	Composite Vehicle Structure	Tow Vehicle/Truck	5	30-40
514	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	Tow Vehicle/Truck	5	30-40
515	358	Thermoplastic Repairs By Bonding With Induction Heating	Tow Vehicle/Truck	5	30-40
516	19	Clamshelter	Environmental	4	25-30
517	63	Helmet Mounted Display for USN Forklift Drivers	Cargo Handling	4	15-20
518	63	Helmet Mounted Display for USN Forklift Drivers	Deployment	4	15-20
519	63	Helmet Mounted Display for USN Forklift Drivers	Lift Truck/Jammer	4	15-20
520	64	Relocatable, Expandable Shelters for US Army Aviation Maintenance	Environmental	4	25-30
521	82	UK Army Support Services Computer System (UNICOM)	General SE	4	25-30
522	84	Canadian Handheld Explosives Detector for Vehicle Inspections	Deployment	4	15-20
523	101	Hydrazine Calorimetric Leak Sensor	Special Purpose Flightline	4	25-30
524	194	MF1 Silicon Foam for Fire Blocking, and Thermal & Acoustic Insulation	Deployment	4	5-15
525	199	Zinc-Based Alloy Films for Highly Corrosion-Resistant Protection	Tools	4	40-45
526	201	Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches	General SE	4	0-5
527	242	Quadrupole Resonance Technology for Plastic Explosives Detection	Deployment	4	25-30
528	264	The Rubb Rapid Erect Building for Flightline Maintenance/Storage	Environmental	4	25-30
529	296	Nonflammable Foam-In-Place Insulation - Polyimide Materials	Deployment	4	5-15
530	341	Stressed Arch Hangars for Rapid, 100-Ft High Clear-Span Construction	Environmental	4	25-30
531	14	Transportable Missile Storage Racks	Deployment	3	15-20
532	86	Active Noise Reduction (ANR) Headsets for Armored Vehicle Operators	Misc In-Shop Equipment	3	15-20

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
533	86	Active Noise Reduction (ANR) Headsets for Armored Vehicle Operators	Hydraulic Equipment	3	15-20
534	96	Noise Canceling Headsets (HMEC45-45KA/CA)	Hydraulic Equipment	3	15-20
535	96	Noise Canceling Headsets (HMEC45-45KA/CA)	Misc In-Shop Equipment	3	15-20
536	113	Limited Slip Differentials Designed to Provide Improved Vehicle Traction	Tow Vehicle/Truck	3	15-20
537	168	Concrete Solar Cells as a DC Power Source at Remote Locations	Auxiliary Lighting	3	50-65
538	170	Noise Canceling Engine Test Cells Using an Anti-Sound Field	Facility	3	0-5
539	178	Long-Life Solid State Arrays for DC Power Generation	Auxiliary Lighting	3	50-65
540	254	Heat Shrink Bar Code Labels on Identification Sleeves	Auxiliary Lighting	3	0-5
541	271	Aircraft Tire Leasing for Reduced Inventory and Recycling Benefits	General SE	3	0-5
542	18	Wash Rack Facility with Water Recycling	Environmental	2	45-50
543	24	Whisper Wash Spray System	Environmental	2	25-30
544	142	"Clean & Silent" Diesel Engines	Environmental	2	15-20
545	174	Aviation Battery Quick Disconnect	General SE	2	0-5
546	182	Advanced Derivative JP-Fuel to Cut Maintenance Costs	Ground Power/Start Cart	2	5-10
547	197	RF-120 Thermal Composite Material	Deployment	2	15-20
548	208	Fire-Retardant Kevlar Blankets with Silicon Coatings	Deployment	2	15-20
549	213	Machinable, Noncorrosive Coating to Refurbish Aircraft Components	Deployment	2	90-95
550	215	LD-3-Sized Blast Resistant Luggage Container	Deployment	2	40-45
551	219	Audible Flightline Tool Locator System for Aircraft	Tools	2	15-20
552	227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	Hydraulic Equipment	2	0-5
553	227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	Auxiliary Lighting	2	0-5
554	227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	General SE	2	0-5
555	269	Gas-Fired Infrared Heating Deicers for Commercial Aircraft	Environmental	2	40-45
556	327	Hydraulic Connector	Hydraulic Equipment	2	0-5
557	49	Digital Power Monitor for Ground AC/DC Power Systems (Logitek)	Auxiliary Lighting	1	25-30
558	49	Digital Power Monitor for Ground AC/DC Power Systems (Logitek)	Ground Power/Start Cart	1	25-30
559	158	Super Lightweight Fuel Tank	Misc In-Shop Equipment	1	50-55
560	158	Super Lightweight Fuel Tank	Cargo Handling	1	50-55
561	158	Super Lightweight Fuel Tank	Air Compressor	1	50-55
562	158	Super Lightweight Fuel Tank	Lift Truck/Jammer	1	50-55
563	158	Super Lightweight Fuel Tank	Auxiliary Lighting	1	50-55
564	158	Super Lightweight Fuel Tank	Hydraulic Equipment	1	50-55
565	158	Super Lightweight Fuel Tank	Air Conditioner	1	50-55
566	158	Super Lightweight Fuel Tank	Heater	1	50-55

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
567	158	Super Lightweight Fuel Tank	General SE	1	50-55
568	158	Super Lightweight Fuel Tank	Special Purpose Flightline	1	50-55
569	158	Super Lightweight Fuel Tank	Tow Vehicle/Truck	1	50-55
570	158	Super Lightweight Fuel Tank	Aircraft Deicer/Washer	1	50-55
571	177	Self-Propelled Helipad	Deployment	1	50-55
572	217	Battery-Powered, 2-Wheeled GreaseKart for High-Pressure Lubrication	General SE	1	0-5
573	317	Lighter Cast-Iron Engine Blocks	Lift Truck/Jammer	1	35-40
574	317	Lighter Cast-Iron Engine Blocks	Air Conditioner	1	35-40
575	317	Lighter Cast-Iron Engine Blocks	Aircraft Deicer/Washer	1	35-40
576	317	Lighter Cast-Iron Engine Blocks	Hydraulic Equipment	1	35-40
577	317	Lighter Cast-Iron Engine Blocks	Cargo Handling	1	35-40
578	317	Lighter Cast-Iron Engine Blocks	Ground Power/Start Cart	1	35-40
579	317	Lighter Cast-Iron Engine Blocks	Tow Vehicle/Truck	1	35-40
580	11	Robotic X-Ray	General SE	0	0-0
581	12	Robotic Replenishment of Consumables	Environmental	0	0-0
582	25	Spray-On Shifting Camouflage Coatings for Aircraft	General SE	0	50-55
583	32	Nonmetallic Aircraft Fasteners with Superior Pull-Out Strength	General SE	0	0-0
584	45	Stainless Steel Foil Insulation Blankets for Jet Engine Thrust Reversers	General SE	0	0-0
585	48	Noise and Vibration Damping Composites for Vehicles (Tufcote)	Ground Power/Start Cart	0	25-30
586	54	Non-Drip, Fuel and Oil Resistant Epoxy Coating/Sealant	General SE	0	0-0
587	55	Large Capacity USAF Aircraft Cargo Loader (60K)	Cargo Handling	0	0-0
588	56	Modification for USAF Aircraft Cargo Loader (12K)	Cargo Handling	0	0-0
589	61	Tinker ALC Technology Insertion Study Contract	General SE	0	0-0
590	65	Rigid, Lightweight Closed Cell Foam Insulation (LST 2) for UK Ships	General SE	0	0-0
591	68	Steel-Like Material for Bleed Air Ducts (Inconel)	Air Compressor	0	15-20
592	68	Steel-Like Material for Bleed Air Ducts (Inconel)	Lift Truck/Jammer	0	15-20
593	68	Steel-Like Material for Bleed Air Ducts (Inconel)	Air Conditioner	0	15-20
594	69	RAF's Warehouse and Transportation Management System (WTMS)	General SE	0	0-0
595	70	Australian Fatigue Patching Technology for C-141 StarLifter	Maintenance Stand	0	0-0
596	70	Australian Fatigue Patching Technology for C-141 StarLifter	Ground Power/Start Cart	0	0-0
597	70	Australian Fatigue Patching Technology for C-141 StarLifter	General SE	0	0-0
598	70	Australian Fatigue Patching Technology for C-141 StarLifter	Air Conditioner	0	0-0
599	70	Australian Fatigue Patching Technology for C-141 StarLifter	Air Compressor	0	0-0
600	72	Portable Flightline Tester for USAF and USN Aircraft Radios	Test Set	0	0-0

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
601	75	UK RAF Logistics Support System (LSS) - ILS Support	General SE	0	0-0
602	76	UK RAFLogistics Support System (LSS) - Database Development	General SE	0	0-0
603	77	US Army Palletized Load System Compatibility-Conversion Contract	General SE	0	0-0
604	79	UK Contract for New Generation Camouflage Materials	General SE	0	0-0
605	80	USAF Contract for Nuclear Hardness Maintenance/Surveillance Systems	General SE	0	0-0
606	89	UK RAF Logistics Information Technology Strategy (LITS) - Mgt Support	General SE	0	0-0
607	90	UK RAF Logistics Information Technology Strategy (LITS) - Software	General SE	0	0-0
608	91	Offshore Bulk Fuel Storage, Transfer and Delivery System (Dracone)	Ground Power/Start Cart	0	0-0
609	92	Extra Compliant, Nylon-Belted Aircraft Tires	General SE	0	0-0
610	94	Pre-Takeoff Ice Detection System (HALO)	Environmental	0	0-0
611	100	Advanced Cooling For Starter/Generators & Magnetic Bearings With Heat Pipes & Thermosyphons	General SE	0	0-0
612	102	Advanced Molybdate Conversion Coatings For Aluminum And Its Alloys	General SE	0	0-0
613	103	A Surface Acoustic Wave Corrosion Sensor For Spacecraft And Support Systems	General SE	0	0-0
614	104	Self-Monitoring, Self-Cleaning, Self-Calibrating pH Sensor	General SE	0	0-0
615	105	Innovative Corrosion Inhibitor Compounds From Tobacco Extracts	Air Conditioner	0	0-0
616	105	Innovative Corrosion Inhibitor Compounds From Tobacco Extracts	Maintenance Stand	0	0-0
617	106	All-Position Superconducting Magnetic Dewar For Dispensing Liquid Oxygen In Self-Contained Breathing Apparatus	Environmental	0	0-0
618	108	Blackbody Photoreactor For Scrubbing Of Hazardous Waste	Environmental	0	0-0
619	115	Composites Diagnose Aircraft Defects	General SE	0	0-0
620	116	Blind Fastener Applies Self-Sealants	Ground Power/Start Cart	0	0-0
621	116	Blind Fastener Applies Self-Sealants	Auxiliary Lighting	0	0-0
622	117	Future May Hold Accelerated use of Nylon in Auto Manifolds	General SE	0	25-30
623	118	Advanced Lead Acid Batteries	Misc In-Shop Equipment	0	0-0
624	118	Advanced Lead Acid Batteries	Lift Truck/Jammer	0	0-0
625	118	Advanced Lead Acid Batteries	Special Purpose Flightline	0	0-0
626	118	Advanced Lead Acid Batteries	Auxiliary Lighting	0	0-0
627	118	Advanced Lead Acid Batteries	Environmental	0	0-0
628	118	Advanced Lead Acid Batteries	General SE	0	0-0
629	118	Advanced Lead Acid Batteries	Ground Power/Start Cart	0	0-0
630	118	Advanced Lead Acid Batteries	Hydraulic Equipment	0	0-0
631	118	Advanced Lead Acid Batteries	Air Compressor	0	0-0
632	120	Mobile Computing Combo	General SE	0	0-0
633	127	Aluminum, Copper Nested Fin Heat Exchangers Designed for Consistent Thermal Performance	General SE	0	0-0

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
634	127	Aluminum, Copper Nested Fin Heat Exchangers Designed for Consistent Thermal Performance	Hydraulic Equipment	0	0-0
635	128	Water Systems Impinge on CFC cleaning Methods	Environmental	0	0-0
636	130	Diesel-Powered Portable Pumps Target Firefighting, Irrigation, Dewatering	General SE	0	0-0
637	132	Thermal Protection System	Heater	0	25-30
638	132	Thermal Protection System	Air Conditioner	0	25-30
639	134	Development of Alcohol Fueled Engines	Environmental	0	0-0
640	134	Development of Alcohol Fueled Engines	General SE	0	0-0
641	135	Multi-Objective Process Planing in Environmentally Conscious Manufacturing	Environmental	0	0-0
642	137	Vegetable Based Industrial Fluids for Military Green Efforts	General SE	0	0-0
643	138	Hydro Mite Strut Servicing Equipment	Special Purpose Flightline	0	0-0
644	143	Energy Storage System	General SE	0	0-0
645	144	Supersonic Gas-Liquid Cleaning System	Environmental	0	0-0
646	144	Supersonic Gas-Liquid Cleaning System	General SE	0	0-0
647	144	Supersonic Gas-Liquid Cleaning System	Misc In-Shop Equipment	0	0-0
648	144	Supersonic Gas-Liquid Cleaning System	Aircraft Deicer/Washer	0	0-0
649	145	Lubricants	General SE	0	0-0
650	146	Torque Drive System	Tools	0	0-5
651	147	Thermal Coating System	Environmental	0	0-0
652	149	Flat Panel Display	General SE	0	0-0
653	151	Noise Attenuation Material	Ground Power/Start Cart	0	25-30
654	154	Air Particle Separators	Ground Power/Start Cart	0	0-0
655	157	Thermal Switch Disc for Short-Circuit Protection of Batteries	General SE	0	0-0
656	161	A New Life For Old Tires	Environmental	0	0-0
657	163	Recycled Rubber Material	Environmental	0	0-0
658	167	Design Standardization of Composite Parts for Durability and Repairability	General SE	0	0-0
659	169	Electro-Optical Ice Detection System Using False-Color Imaging	Environmental	0	0-0
660	171	Novel Fiber Pad Connection for Attaching Heat Sink to Heat Source	Lift Truck/Jammer	0	0-0
661	171	Novel Fiber Pad Connection for Attaching Heat Sink to Heat Source	Heater	0	0-0
662	179	Low-Cost Carbon Carbon Composite Production Technique	General SE	0	0-0
663	181	New Processible, High-Temperature Composite Resin	General SE	0	0-0
664	186	Chemical Gas (Fuel-Rich, Combined Cycle) Turbine System	Ground Power/Start Cart	0	0-0
665	189	Quick-Knockdown, Side-Loading Shipping Crates	Deployment	0	0-0
666	207	Lightweight Pocket Laser Communicator	General SE	0	0-0
667	213	Machinable, Noncorrosive Coating to Refurbish Aircraft Components	General SE	0	0-0
668	228	Molded Urethane Flightline Chocks	General SE	0	0-5
669	230	Containerized Field Laundry with No Diesel Fuel Smell in Undershorts	Environmental	0	0-0

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
670	232	Highly Maneuverable Robotic Maintenance Scanners for Aircraft	General SE	0	0-0
671	239	Thin Film Lithium Battery	Test Set	0	65-70
672	240	Hydrostatic Bearing Technologies (Liquid Bearings)	Ground Power/Start Cart	0	90-95
673	244	Light-Emitting Sheets of Plastic for Aircraft	Servicing	0	50-55
674	244	Light-Emitting Sheets of Plastic for Aircraft	Hydraulic Equipment	0	50-55
675	244	Light-Emitting Sheets of Plastic for Aircraft	Heater	0	50-55
676	246	Ceramic Capacitive Sensing Technology - Bleed Air Pressure Sensor	Special Purpose Flightline	0	15-20
677	248	Vapor Phase Lubrication Technology - Polymeric Lubricating Film	General SE	0	0-0
678	249	Large Flow-Rate, Thin-Foil Fluid Filters	General SE	0	0-0
679	252	Hollow Bearing Rollers for Higher Speeds/Lower Temperatures	Ground Power/Start Cart	0	25-30
680	260	New Lightweight ECS Ducting Resists Crushing, Oils and Solvents	Air Compressor	0	15-20
681	260	New Lightweight ECS Ducting Resists Crushing, Oils and Solvents	Lift Truck/Jammer	0	15-20
682	260	New Lightweight ECS Ducting Resists Crushing, Oils and Solvents	Air Conditioner	0	15-20
683	263	New Aircrew Emergency Bailout Parachute System	Hoist/Slings/Cranes	0	0-0
684	266	New Dent Removal Process for Aluminum Aircraft Structures	General SE	0	0-0
685	267	Electromagnetic Aircraft Launch System for Aircraft Carriers	General SE	0	0-0
686	268	Composite Repair Technology for Metallic Aircraft Structures	Maintenance Stand	0	0-0
687	268	Composite Repair Technology for Metallic Aircraft Structures	Air Conditioner	0	0-0
688	268	Composite Repair Technology for Metallic Aircraft Structures	Air Compressor	0	0-0
689	268	Composite Repair Technology for Metallic Aircraft Structures	Ground Power/Start Cart	0	0-0
690	268	Composite Repair Technology for Metallic Aircraft Structures	General SE	0	0-0
691	270	Plug-In, Solid-State Replacement Altimeter for 1960s-Vintage Altimeters	Test Set	0	0-0
692	273	Non-Contact Magnetic Bearings for Gas Turbine Engines	Ground Power/Start Cart	0	90-95
693	281	Directed Laser Fabrication Process for Speedy Prototyping of Parts	General SE	0	0-0
694	284	Self-Locking Set Screws	General SE	0	0-0
695	287	Epoxy Prepreg	General SE	0	0-0
696	290	Strategic Sourcing for Vehicle Maintenance	General SE	0	0-0
697	295	Lockable Worm Gear Hose Clamp - The Pintite SS	Air Conditioner	0	0-5
698	303	Passenger Presence Detection	General SE	0	0-0
699	305	Compressed-Air Filters by IMI Norgren Inc., Littleton, Colo.	Air Compressor	0	0-0
700	308	Improved Fiber-Optic Connectors	Test Set	0	0-0
701	311	Heat-Activated Cooling Systems	Air Conditioner	0	0-0
702	312	Powerful Hydraulic Pumps	Jack	0	0-0

Rank:	Tech #:	Tech Name:	Equipment Type:	Score:	Risk/Cost:
703	314	Filter/Regulator/Lubricator (FRL) Systems	Air Compressor	0	0-0
704	315	Horton-Global Series PTO Clutch	Cargo Handling	0	0-0
705	318	Lead-Free Bearings	Ground Power/Start Cart	0	0-0
706	319	Composite Seal and Filter	General SE	0	0-0
707	321	Slick 50® LongLife Grease	Gun/Loading	0	0-5
708	323	Direct-Drive Minigauges	General SE	0	0-0
709	324	High-Performance Butterfly Valves	General SE	0	0-0
710	325	Parts Cleaner	Misc In-Shop Equipment	0	15-20
711	326	Pipe-Cutting Machines (Mactech Inc., Red Wing, Minn.)	Misc In-Shop Equipment	0	0-0
712	328	Industrial Borescopes	Test Set	0	15-20
713	329	Powertrain Electronics	Cargo Handling	0	0-0
714	329	Powertrain Electronics	Lift Truck/Jammer	0	0-0
715	329	Powertrain Electronics	Tow Vehicle/Truck	0	0-0
716	331	Hydraulic-Fluid Hose	Hydraulic Equipment	0	0-0
717	331	Hydraulic-Fluid Hose	Deployment	0	0-0
718	332	Portable Blind- Riveting Tool	Misc In-Shop Equipment	0	0-0
719	335	Torqueless Nut	Maintenance Stand	0	0-0
720	335	Torqueless Nut	Misc In-Shop Equipment	0	0-0
721	342	Buddy Start System for Aircraft	Ground Power/Start Cart	0	0-0
722	345	Lithium Iron Disulfide Battery for Aircraft	General SE	0	0-0
723	347	On-Board Engine Oil Analysis System for Aircraft	Misc In-Shop Equipment	0	0-0
724	349	Auto-Steer Controller for Aircraft	General SE	0	0-0
725	350	Aircraft-Mounted Refueling Pump	Servicing	0	0-0
726	351	Air Bag Weapon Ejectors for Aircraft	General SE	0	0-0
727	352	All-Hydraulic Conformal Ejector Rack for Aircraft	General SE	0	0-0
728	354	Caseless Ammunition & Gun System For Aircraft	Gun/Loading	0	0-0
729	355	Electrical Start System for Aircraft	General SE	0	0-0
730	359	Integrated Circuit MicroDisc for Aircraft	General SE	0	0-0
731	362	Low-Cost ACES-2 Ejection Seat for Aircraft	Hoist/Slings/Cranes	0	0-0
732	363	Superconducting Magnetic Bearings for Gas Turbine Engines	Ground Power/Start Cart	0	90-95
733	365	Airframe Rigging System (ARS) for Aircraft	General SE	0	0-0
734	367	Lithium Chlorine Battery for Aircraft	General SE	0	0-0
735	368	Fuel Cell Reformer & Hydrogen Reactor Technology	General SE	0	0-0

Technology Prioritization By Equipment

Ground Power/Start Cart — **Sum Of Unique Severity Factors: 325**

ID:	Technology:	Score:	Risk/Cost:						
1	Multifunction Aircraft Ground Support System (MAGSS)	211	15-20	UP					
27	Reduced Maintenance Batteries	10	70-80				VP		
31	High-Purity Ceramics for High-Temp Strength and Corrosion Resistance	10	50-55						
33	Thermostatically-Controlled Resistive Heaters	18	0-5						
34	Hybrid Gas/Powder Fire Extinguishing Agent (Halon-Free)	39	0-5						
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	57	30-40		CP				
36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	57	30-40		CP				
37	Piezoresistive Shock and Vibration Data Recorder	10	15-20						
43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	35	50-60						
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	57	30-40		CP				
46	Laminated Heat Spreaders for IC Devices (T-Wing)	15	0-5						
47	SpiderClip Heat Sinks for IC Devices (No Adhesives)	15	0-5						
48	Noise and Vibration Damping Composites for Vehicles (Tufcote)	0	25-30						
49	Digital Power Monitor for Ground AC/DC Power Systems (Logitek)	1	25-30						
70	Australian Fatigue Patching Technology for C-141 StarLifter	0	0-0						
78	Lithium Solid Polymer Electrolyte Batteries	10	70-80				VP		
86	Active Noise Reduction (ANR) Headsets for Armored Vehicle Operators	6	15-20						
91	Offshore Bulk Fuel Storage, Transfer and Delivery System (Dracone)	0	0-0						
96	Noise Canceling Headsets (HMEC45-45KA/CA)	6	15-20						
116	Blind Fastener Applies Self-Sealants	0	0-0						
118	Advanced Lead Acid Batteries	0	0-0						
121	Stove-top Generator Lights Arctic Nights	14	0-0						
129	A Single Gauge Versus an Instrument Cluster	8	20-25						
133	All-Plastic Battery	10	70-80				VP		
136	High Efficiency Propulsion System	50	75-80					ER	
151	Noise Attenuation Material	0	25-30						
154	Air Particle Separators	0	0-0						
155	High Reliability Maintenance-Free Battery	10	70-80				VP		
158	Super Lightweight Fuel Tank	6	50-55						
159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	19	15-20			LP			
182	Advanced Derivative JP-Fuel to Cut Maintenance Costs	2	5-10						
186	Chemical Gas (Fuel-Rich, Combined Cycle) Turbine System	0	0-0						

187	Diamond-Coated Ceramic Ball Bearings	15	15-20			BP			
188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	57	30-40		CP				
198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	57	30-40		CP				
202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	57	30-40		CP				
216	Self-Sealing Fasteners for Anti-Leak Requirements	43	0-5		FP				
227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	8	0-5						
233	Solar Power to Extend Battery Life (Solargizers)	10	15-20				VP		
238	All-Plastic, Solid State Battery	10	70-80				VP		
240	Hydrostatic Bearing Technologies (Liquid Bearings)	0	90-95			BP			
243	Computerized System to Track Limited-Life, On-Condition Components	100	15-20						
245	Comprehensive Integrated Mechanical Diagnostics System	11	25-30						
250	Self-Locking Heat Sink for Surface Mounted Components	15	0-5						
252	Hollow Bearing Rollers for Higher Speeds/Lower Temperatures	0	25-30			BP			
253	Electrically Heated Fluid Reservoir Heater	18	0-5						
261	Tri-Color Bargraph System for LED Instruments	22	15-20						
268	Composite Repair Technology for Metallic Aircraft Structures	0	0-0						
273	Non-Contact Magnetic Bearings for Gas Turbine Engines	0	90-95			BP			
274	Smart Material Compensator Rings for Turbine Engines	6	75-80			SP			
275	Active, Predictive Blade Tip Clearance System for Turbine Engines	6	75-80						
280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	57	30-40		CP				
282	Whisper Power Ground Power Unit From Hobart	276	10-15	UP					
285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	58	0-5			SP			
292	The Jetpower PMW 400 Hz Converter	42	40-45						
298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	218	90-95	UP					ER
302	Split-Cycle Technology Engine	57	90-95						ER
306	Composite Vehicle Structure	57	30-40		CP				
317	Lighter Cast-Iron Engine Blocks	1	35-40						
318	Lead-Free Bearings	0	0-0						
320	Composite Wrapped Gaskets	8	25-30						
322	MagneStrap	19	15-20			LP			
330	Circuit Breaker Switch Panels	22	0-5						
334	Oil-Resistant Silicone	58	0-5			SP			
336	Vibration Meter	11	25-30						
337	Thermoforming for Fabricating Lightweight Structural Composite Materials	57	30-40		CP				
342	Buddy Start System for Aircraft	0	0-0						
346	Low Maintenance Battery System for Aircraft	10	70-80				VP		
356	Multiple Integrated Power Unit (MIPU) For Aircraft	220	65-70	UR					

358	Thermoplastic Repairs By Bonding With Induction Heating	57	30-40		CP			
363	Superconducting Magnetic Bearings for Gas Turbine Engines	0	90-95			BP		
364	Two-Year Batteries for Aircraft	10	70-80				VP	
	PRIORITIZATION				**3**	**1N**	**2**	**1F**

LEGEND:

U: Unit Replacement
C: Composites
B: Bearings
L: Lubricants
S: Seals
V: Batteries
E: Engines

R: Research
P: PIWG Action Item

N: Near Term
F: Far Term

General SE **Sum Of Unique Severity Factors: 245**

ID:	Technology:	Score:	Risk/Cost:							
1	Multifunction Aircraft Ground Support System (MAGSS)	108	20-25							
3	Expert Decision Support Software to Speed Maintenance	17	10-15		IR					
4	Warrior Vision	67	65-70		IR					
6	Automated Tech Order System	62	0-5		IP					
7	Integrated Maintenance Information System	67	65-70		IP					
11	Robotic X-Ray	0	0-0							
13	CBR Facility for Decontamination, Deicing and Refueling	28	75-80							
25	Spray-On Shifting Camouflage Coatings for Aircraft	0	50-55	CP						
27	Reduced Maintenance Batteries	18	70-80			VP				
29	Oil Analysis Spectrometer	18	0-5					EP		
32	Nonmetallic Aircraft Fasteners with Superior Pull-Out Strength	0	0-0							
33	Thermostatically-Controlled Resistive Heaters	18	0-5					EP		
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	30	30-40	CP						
36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	30	30-40	CP						
38	Microprocessor Engine Control System with Engine Parameter Sensing	26	10-15					EP		
39	Fully-Electronic AWG and Power Cable Cutter/Stripper/Processor	15	40-45							
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	30	30-40	CP						
45	Stainless Steel Foil Insulation Blankets for Jet Engine Thrust Reversers	0	0-0							
50	Portable Bar Code Printer for Warehouse Pallets (K2000)	33	0-5		IP					
52	Long-Term, Salt Water-Displacing Corrosion Inhibitor for Aircraft	10	0-5	CP						
53	Viscous Resin Thread-Locking Compound (Vibra-Tite)	24	0-5	CP						
54	Non-Drip, Fuel and Oil Resistant Epoxy Coating/Sealant	0	0-0							
57	USMC Mobile Fuel Filtration Trailer	30	25-30							
58	SwRI's Smart Beacon Package to Locate Anything, Anywhere	30	50-55		IP					
59	Contractor Refurbishment of RAAF Ground Support Equipment	11	0-5							
61	Tinker ALC Technology Insertion Study Contract	0	0-0							
62	Savi Asset Management and Transportation Management System	30	50-55		IP					
65	Rigid, Lightweight Closed Cell Foam Insulation (LST 2) for UK Ships	0	0-0							
69	RAF's Warehouse and Transportation Management System (WTMS)	0	0-0							
70	Australian Fatigue Patching Technology for C-141 StarLifter	0	0-0							
74	UK Contracts to Study Equipment Cost and Operation Implications	20	25-30							
75	UK RAF Logistics Support System (LSS) - ILS Support	0	0-0							
76	UK RAFLogistics Support System (LSS) - Database Development	0	0-0							

77	US Army Palletized Load System Compatibility-Conversion Contract	0	0-0						
78	Lithium Solid Polymer Electrolyte Batteries	18	70-80			VP			
79	UK Contract for New Generation Camouflage Materials	0	0-0						
80	USAF Contract for Nuclear Hardness Maintenance/Surveillance Systems	0	0-0						
81	UK Army Ground Equipment Assessment and Support Database Program	20	25-30		IP				
82	UK Army Support Services Computer System (UNICOM)	4	25-30		IP				
83	UK Royal Navy Computerized Illustrated Parts Catalog for Naval Vessels	62	0-5		IP				
85	Advanced Cost Modeling Tools for JAST Design Assessments	20	25-30		IR				
86	Active Noise Reduction (ANR) Headsets for Armored Vehicle Operators	18	15-20				HP		
89	UK RAF Logistics Information Technology Strategy (LITS) - Mgt Support	0	0-0						
90	UK RAF Logistics Information Technology Strategy (LITS) - Software	0	0-0						
92	Extra Compliant, Nylon-Belted Aircraft Tires	0	0-0						
93	Polyurethane Topcoats for Aircraft and Support Equipment	13	0-5	CP					
96	Noise Canceling Headsets (HMEC45-45KA/CA)	18	15-20				HP		
98	Diffusional Coatings For Flight Hardware And Ground Support Equipment	13	50-55	CP					
100	Advanced Cooling For Starter/Generators & Magnetic Bearings With Heat Pipes & Thermosyphons	0	0-0						
102	Advanced Molybdate Conversion Coatings For Aluminum And Its Alloys	0	0-0						
103	A Surface Acoustic Wave Corrosion Sensor For Spacecraft And Support Systems	0	0-0						
104	Self-Monitoring, Self-Cleaning, Self-Calibrating pH Sensor	0	0-0						
115	Composites Diagnose Aircraft Defects	0	0-0						
117	Future May Hold Accelerated use of Nylon in Auto Manifolds	0	25-30						
118	Advanced Lead Acid Batteries	0	0-0						
120	Mobile Computing Combo	0	0-0						
122	Automatic Engine Stop/Start System	20	25-30				HP		
123	Polyester Material for Fasteners	24	0-5	FP					
125	Calibrated Bolt Indicated Tension	5	15-20	FP					
127	Aluminum, Copper Nested Fin Heat Exchangers Designed for Consistent Thermal Performance	0	0-0						
130	Diesel-Powered Portable Pumps Target Firefighting, Irrigation, Dewatering	0	0-0						
133	All-Plastic Battery	18	70-80			VP			
134	Development of Alcohol Fueled Engines	0	0-0						
137	Vegetable Based Industrial Fluids for Military Green Efforts	0	0-0						
139	Universal Data Logger	14	20-25		IP				
142	"Clean & Silent" Diesel Engines	10	15-20					EP	
143	Energy Storage System	0	0-0						
144	Supersonic Gas-Liquid Cleaning System	0	0-0						

145	Lubricants	0	0-0							
149	Flat Panel Display	0	0-0							
155	High Reliability Maintenance-Free Battery	18	70-80			VP				
157	Thermal Switch Disc for Short-Circuit Protection of Batteries	0	0-0							
158	Super Lightweight Fuel Tank	1	50-55							
159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	7	15-20							LP
164	Virtual Maintainer' Speeds Flightline Troubleshooting	17	10-15		IR					
167	Design Standardization of Composite Parts for Durability and Repairability	0	0-0							
174	Aviation Battery Quick Disconnect	2	0-5			VP				
179	Low-Cost Carbon Carbon Composite Production Technique	0	0-0							
180	Wristwatch-Size GPS Receivers for Embedded Applications	30	50-55		IP					
181	New Processible, High-Temperature Composite Resin	0	0-0							
183	Scandinavian Bellyloader - Sliding Carpet Cargo Loading System	5	15-20							
184	Air Transportable Cargo Loader for Forward Location Self-Sufficiency	15	25-30							
188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	30	30-40	CP						
191	Advanced Self-Locking Fastener With Reusable Nut Sleeve & Lock Ring	24	0-5	FP						
192	Omni-Lok Self-Locking Fastener for High-Temperature Applications	24	0-5	FP						
195	DUAL-LOK Self-Locking Fastener for High-Temperature Applications	24	0-5	FP						
196	Tough Engineering Plastic Resins for Corrosion-Resistant Coatings	13	0-5	CP						
198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	30	30-40	CP						
201	Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches	4	0-5							
202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	30	30-40	CP						
204	Computer-Based Technical Manuals	62	0-5		IP					
206	Interactive Desktop Computer Training Techniques	21	0-5		IP					
207	Lightweight Pocket Laser Communicator	0	0-0							
209	Virtual Classrooms Via Personal Computer Terminals	21	10-15		IP					
210	Streamlined Smart Procurement System by Intelligent Agent Software	57	20-30		IR					
213	Machinable, Noncorrosive Coating to Refurbish Aircraft Components	0	0-0							
216	Self-Sealing Fasteners for Anti-Leak Requirements	17	0-5	FP						
217	Battery-Powered, 2-Wheeled GreaseKart for High-Pressure Lubrication	1	0-5							
221	Interactive Spare Parts Ordering Via Internet	24	30-40		IP					
224	Windows-Based Maintenance Budgeting Software	48	5-10		IP					
227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	2	0-5							
228	Molded Urethane Flightline Chocks	0	0-5							
231	Electron-Beam Curing Process for Composite Parts	28	40-45	CP						

232	Highly Maneuverable Robotic Maintenance Scanners for Aircraft	0	0-0							
233	Solar Power to Extend Battery Life (Solargizers)	18	15-20			VP				
234	Asset Visibility - Improved Automated Logistics Tracking Systems	30	50-55		IR					
235	Focused Logistics (Joint Vision 2010)	88	50-55		IR					
236	A Personal Computer Worn on the Body with Hands-Free Operation	49	45-55		IP					
237	Joint Computer Aided Acquisition and Logistics System (JCALS)	88	50-55		IR					
238	All-Plastic, Solid State Battery	18	70-80			VR				
248	Vapor Phase Lubrication Technology - Polymeric Lubricating Film	0	0-0							
249	Large Flow-Rate, Thin-Foil Fluid Filters	0	0-0							
251	Microwave Reflectometer for Fltline Inspections of LO Material Reflectivity	16	45-50							
253	Electrically Heated Fluid Reservoir Heater	18	0-5						EP	
259	Portable Flightline Lighting System Using Optical Fiber Cables	14	15-20							
261	Tri-Color Bargraph System for LED Instruments	8	15-20					HP		
265	Expanded Capability for the Portable Flightline Tester for Commercial Acft	17	10-15							
266	New Dent Removal Process for Aluminum Aircraft Structures	0	0-0							
267	Electromagnetic Aircraft Launch System for Aircraft Carriers	0	0-0							
268	Composite Repair Technology for Metallic Aircraft Structures	0	0-0							
271	Aircraft Tire Leasing for Reduced Inventory and Recycling Benefits	3	0-5							
272	Avionics Reliability Evaluation Corrective Action Program (RECAP)	24	0-0							
277	Rapid Database Builder For Text, Graphics and Photographs	37	15-20		IP					
278	Patented Surface Hardening Process (Nobleizing) for Valves	16	15-20						EP	
280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	30	30-40	CP						
281	Directed Laser Fabrication Process for Speedy Prototyping of Parts	0	0-0							
283	Self-Locking All-Metal Fastener	24	0-5	FP						
284	Self-Locking Set Screws	0	0-0							
286	High Density Gasket Materials	8	0-5						EP	
287	Epoxy Prepreg	0	0-0							
288	Combat Track - Satellite Linked Logistics Tracking System	30	50-55		IP					
290	Strategic Sourcing for Vehicle Maintenance	0	0-0							
297	RAZ and miniRAZ Munitions Handling Trolleys	40	0-5							
298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	106	90-95						ER	
301	New Non-Volatile Parts Cleaner Developed By McDonnell Douglas Corp	62	25-30					HP		
303	Passenger Presence Detection	0	0-0							
306	Composite Vehicle Structure	30	30-40	CP						
313	Generic Electronics Module	20	25-30			VP			EP	
316	Flow-Through Ion Gun	13	50-55							

319	Composite Seal and Filter	0	0-0								
322	MagneStrap	7	15-20								LP
323	Direct-Drive Minigauges	0	0-0								
324	High-Performance Butterfly Valves	0	0-0								
330	Circuit Breaker Switch Panels	19	0-5						HP		
337	Thermoforming for Fabricating Lightweight Structural Composite Materials	30	30-40	CP							
339	Pulsed Power to Reduce Nitrogen Oxide Emissions from Diesel Engines	40	25-30							ER	
344	Integral Variable Displacement (IVD) Fuel Tank for Aircraft	64	60-65								
345	Lithium Iron Disulfide Battery for Aircraft	0	0-0								
346	Low Maintenance Battery System for Aircraft	18	70-80				VP				
349	Auto-Steer Controller for Aircraft	0	0-0								
351	Air Bag Weapon Ejectors for Aircraft	0	0-0								
352	All-Hydraulic Conformal Ejector Rack for Aircraft	0	0-0								
355	Electrical Start System for Aircraft	0	0-0								
358	Thermoplastic Repairs By Bonding With Induction Heating	30	30-40	CP							
359	Integrated Circuit MicroDisc for Aircraft	0	0-0								
364	Two-Year Batteries for Aircraft	18	70-80				VP				
365	Airframe Rigging System (ARS) for Aircraft	0	0-0								
367	Lithium Chlorine Battery for Aircraft	0	0-0								
368	Fuel Cell Reformer & Hydrogen Reactor Technology	0	0-0								
	PRIORITIZATION			**5**	**1**		**4**		**3**	**2F**	**2N**

LEGEND:

I: Information	R: Research
C: Composites	P: PIWG Action Item
H: Human Factors	
L: Lubricants	N: Near Term
F: Fasteners	F: Far Term
V: Batteries	
E: Engines	

Test Set **Sum Of Unique Severity Factors: 230**

ID:	Technology:	Score:	Risk/Cost:					
66	UK RAF Air Data Test Sets with Contractor Support	11	0-5					
72	Portable Flightline Tester for USAF and USN Aircraft Radios	0	0-0					
73	Australian Contractor Support for Calibration & Repair of RAAF Test Sets	11	0-5					
173	Advanced Graphical Multimeter	31	15-20					
201	Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches	15	0-5		FP			
216	Self-Sealing Fasteners for Anti-Leak Requirements	15	0-5		FP			
239	Thin Film Lithium Battery	0	65-70					
262	Portable Computer Diagnostic System for F-16 Flightline Maintenance	133	45-50	UR				
270	Plug-In, Solid-State Replacement Altimeter for 1960s-Vintage Altimeters	0	0-0					
308	Improved Fiber-Optic Connectors	0	0-0					
328	Industrial Borescopes	0	15-20					
330	Circuit Breaker Switch Panels	7	0-5					
340	Gold DotTM Technology for Oxide-Free Electrical Contacts	50	50-55		FP			
366	Hierarchical Diagnostic System (HDS) for Aircraft	6	40-45					
	PRIORITIZATION				**3**	**1N**	**2**	**1F**

LEGEND:

U: Unit Replacement
F: Fasteners
R: Research
P: PIWG Action Item

N: Near Term
F: Far Term

Lift Truck/Jammer ID:	Technology:	Sum Of Unique Severity Factors: 181 Score:	Risk/Cost:						
27	Reduced Maintenance Batteries	22	70-80						
33	Thermostatically-Controlled Resistive Heaters	16	0-5		EP				
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	18	30-40	CP					
36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	12	30-40	CP					
40	Rare-Earth Magnet Direct Drive Servovalves (DDV), Electrically Controlled	197	25-30			AR			
41	High Pressure Miniature Hydraulic Pumps (Fixed or Variable)	37	40-45			AR			
43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	44	50-60	CP					
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	18	30-40	CP					
63	Helmet Mounted Display for USN Forklift Drivers	4	15-20						
68	Steel-Like Material for Bleed Air Ducts (Inconel)	0	15-20						
78	Lithium Solid Polymer Electrolyte Batteries	22	70-80						
87	Trapeze Launcher Actuator Assembly for the F-22 Next Generation Fighter	46	40-45				UR		
97	Bumpy Bar Codes for Aircraft Tires	6	15-20						
118	Advanced Lead Acid Batteries	0	0-0						
129	A Single Gauge Versus an Instrument Cluster	6	20-25						
133	All-Plastic Battery	22	70-80						
152	Electrohydrostatic Actuation (EHA) System for Primary Flight Controls	197	25-30			AP			
155	High Reliability Maintenance-Free Battery	22	70-80						
158	Super Lightweight Fuel Tank	1	50-55						
159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	9	15-20		LP				
171	Novel Fiber Pad Connection for Attaching Heat Sink to Heat Source	0	0-0						
172	Shift Shock Stop - Transmission Protection Device	27	15-20		EP				
185	Carbon Foam Material for Insulation, High-Temp Filters and Engine Parts	7	75-80		EP				
188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	18	30-40	CP					
198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	12	30-40	CP					
201	Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches	14	0-5			AP			
202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	12	30-40	CP					
227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	5	0-5			AP			
233	Solar Power to Extend Battery Life (Solargizers)	22	15-20						
238	All-Plastic, Solid State Battery	22	70-80						
253	Electrically Heated Fluid Reservoir Heater	16	0-5		EP				
254	Heat Shrink Bar Code Labels on Identification Sleeves	15	0-5						

260	New Lightweight ECS Ducting Resists Crushing, Oils and Solvents	0	15-20					
271	Aircraft Tire Leasing for Reduced Inventory and Recycling Benefits	15	0-5					
280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	12	30-40	CP				
285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	12	0-5			AP		
297	RAZ and miniRAZ Munitions Handling Trolleys	252	0-5				UP	
306	Composite Vehicle Structure	18	30-40	CP				
309	Electric Vehicles	195	40-45		ER			
317	Lighter Cast-Iron Engine Blocks	1	35-40		EP			
322	MagneStrap	9	15-20		LP			
329	Powertrain Electronics	0	0-0					
330	Circuit Breaker Switch Panels	46	0-5		EP			
334	Oil-Resistant Silicone	12	0-5		SP			
337	Thermoforming for Fabricating Lightweight Structural Composite Materials	12	30-40	CP				
338	Hobbs Electronic FNR Shifter for Off-Road Equipment	27	15-20		EP			
346	Low Maintenance Battery System for Aircraft	22	70-80					
353	Built-In Cable Load Boxes/Drums for Aircraft	46	40-45				UR	
358	Thermoplastic Repairs By Bonding With Induction Heating	12	30-40	CP				
364	Two-Year Batteries for Aircraft	22	70-80					
	PRIORITIZATION			**3**	**2**	**1**		

LEGEND:

U: Unit Replacement
C: Composites
A: Actuators
L: Lubricants
S: Seals
E: Engines

R: Research
P: PIWG Action Item

Air Compressor		Sum Of Unique Severity Factors:	177					
ID:	Technology:	Score:	Risk/Cost:					
1	Multifunction Aircraft Ground Support System (MAGSS)	160	20-25				UP	
27	Reduced Maintenance Batteries	18	70-80					
33	Thermostatically-Controlled Resistive Heaters	16	0-5					
34	Hybrid Gas/Powder Fire Extinguishing Agent (Halon-Free)	39	0-5					
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	102	30-40	CP				
36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	102	30-40	CP				
38	Microprocessor Engine Control System with Engine Parameter Sensing	15	10-15					EP
43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	48	50-60					EP
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	102	30-40	CP				
68	Steel-Like Material for Bleed Air Ducts (Inconel)	0	15-20					
70	Australian Fatigue Patching Technology for C-141 StarLifter	0	0-0					
78	Lithium Solid Polymer Electrolyte Batteries	18	70-80					
118	Advanced Lead Acid Batteries	0	0-0					
133	All-Plastic Battery	18	70-80					
136	High Efficiency Propulsion System	53	75-80					ER
155	High Reliability Maintenance-Free Battery	18	70-80					
158	Super Lightweight Fuel Tank	1	50-55					
159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	24	15-20		LP			
185	Carbon Foam Material for Insulation, High-Temp Filters and Engine Parts	12	75-80					EP
188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	102	30-40	CP				
198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	102	30-40	CP				
201	Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches	37	0-5			AP		
202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	102	30-40	CP				
227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	5	0-5			AP		
233	Solar Power to Extend Battery Life (Solargizers)	18	15-20					
238	All-Plastic, Solid State Battery	18	70-80					
241	Glass-Epoxy-Aluminum Composite for Bonded Repairs	21	25-30					
253	Electrically Heated Fluid Reservoir Heater	16	0-5					EP
260	New Lightweight ECS Ducting Resists Crushing, Oils and Solvents	0	15-20					
268	Composite Repair Technology for Metallic Aircraft Structures	0	0-0					
280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	102	30-40	CP				
285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	24	0-5		SP			

298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	168	90-95				UR	ER
299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical	71	10-15				UP	
302	Split-Cycle Technology Engine	53	75-80					ER
305	Compressed-Air Filters by IMI Norgren Inc., Littleton, Colo.	0	0-0					
306	Composite Vehicle Structure	102	30-40	CP				
314	Filter/Regulator/Lubricator (FRL) Systems	0	0-0					
317	Lighter Cast-Iron Engine Blocks	6	35-40					EP
322	MagneStrap	24	15-20		LP			
330	Circuit Breaker Switch Panels	29	0-5			AP		
334	Oil-Resistant Silicone	24	0-5		SP			
337	Thermoforming for Fabricating Lightweight Structural Composite Materials	102	30-40	CP				
346	Low Maintenance Battery System for Aircraft	18	70-80					
358	Thermoplastic Repairs By Bonding With Induction Heating	102	30-40	CP				
364	Two-Year Batteries for Aircraft	18	70-80					
	PRIORITIZATION			**3**	**2N**	**1**		**2F**

LEGEND:

U: Unit Replacement
C: Composites
A: Actuators
L: Lubricants
S: Seals
E: Engines

R: Research
P: PIWG Action Item

N: Near Term
F: Far Term

Hydraulic Equipment **Sum Of Unique Severity Factors: 161**

ID:	Technology:	Score:	Risk/Cost:						
1	Multifunction Aircraft Ground Support System (MAGSS)	209	25-30	UP					
27	Reduced Maintenance Batteries	18	70-80						
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	21	30-40		CP				
36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	17	30-40		CP				
38	Microprocessor Engine Control System with Engine Parameter Sensing	9	10-15						EP
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	21	30-40		CP				
78	Lithium Solid Polymer Electrolyte Batteries	18	70-80						
86	Active Noise Reduction (ANR) Headsets for Armored Vehicle Operators	3	15-20						
96	Noise Canceling Headsets (HMEC45-45KA/CA)	3	15-20						
118	Advanced Lead Acid Batteries	0	0-0						
127	Aluminum, Copper Nested Fin Heat Exchangers Designed for Consistent Thermal Performance	0	0-0						
129	A Single Gauge Versus an Instrument Cluster	16	20-25				AP		
133	All-Plastic Battery	18	70-80						
136	High Efficiency Propulsion System	35	75-80						ER
155	High Reliability Maintenance-Free Battery	18	70-80						
158	Super Lightweight Fuel Tank	1	50-55						
159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	7	15-20			LP			
188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	21	30-40		CP				
198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	17	30-40		CP				
202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	17	30-40		CP				
216	Self-Sealing Fasteners for Anti-Leak Requirements	21	0-5		FP				
227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	2	0-5						
233	Solar Power to Extend Battery Life (Solargizers)	18	15-20						
238	All-Plastic, Solid State Battery	18	70-80						
244	Light-Emitting Sheets of Plastic for Aircraft	0	50-55				AR		
261	Tri-Color Bargraph System for LED Instruments	10	15-20				AP		
280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	21	30-40		CP				
285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	12	0-5			SP			
298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	209	90-95	UR					ER
299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical	63	10-15	UP					
302	Split-Cycle Technology Engine	35	75-80						ER
306	Composite Vehicle Structure	21	30-40		CP				
317	Lighter Cast-Iron Engine Blocks	1	35-40						EP
322	MagneStrap	7	15-20			LP			

327	Hydraulic Connector	2	0-5					
330	Circuit Breaker Switch Panels	7	0-5					
331	Hydraulic-Fluid Hose	0	0-0					
334	Oil-Resistant Silicone	12	0-5					
337	Thermoforming for Fabricating Lightweight Structural Composite Materials	17	30-40					
346	Low Maintenance Battery System for Aircraft	18	70-80					
358	Thermoplastic Repairs By Bonding With Induction Heating	17	30-40					
364	Two-Year Batteries for Aircraft	18	70-80					
	PRIORITIZATION			**2**	**4**	**1**	**1**	**3**

LEGEND:

U: Unit Replacement
C: Composites
F: Fasteners
L: Lubricants
S: Seals
A: Accessories
E: Engines

R: Research
P: PIWG Action Item

Maintenance Stand **Sum Of Unique Severity Factors: 155**

ID:	Technology:	Score:	Risk/Cost:						
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	148	30-40		CP				
36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	148	30-40		CP				
43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	37	50-60		CP				
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	164	30-40		CP				
52	Long-Term, Salt Water-Displacing Corrosion Inhibitor for Aircraft	13	0-5			IP			
70	Australian Fatigue Patching Technology for C-141 StarLifter	0	0-0						
93	Polyurethane Topcoats for Aircraft and Support Equipment	14	0-5			IP			
98	Diffusional Coatings For Flight Hardware And Ground Support Equipment	14	50-55			IR			
105	Innovative Corrosion Inhibitor Compounds From Tobacco Extracts	0	0-0						
176	Modular Aircraft Staging System - Maintenance Stands	182	15-20	UR					
188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	148	30-40		CP				
196	Tough Engineering Plastic Resins for Corrosion-Resistant Coatings	15	0-5			IR			
198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	148	30-40		CP				
202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	148	30-40		CP				
203	Aero-Casters for Air Cushioned Movement of Personnel Lifts	14	20-25						
268	Composite Repair Technology for Metallic Aircraft Structures	0	0-0						
280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	148	30-40		CP				
285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	34	0-5						
306	Composite Vehicle Structure	148	30-40		CP				
316	Flow-Through Ion Gun	14	50-55			IR			
334	Oil-Resistant Silicone	34	0-5						
335	Torqueless Nut	0	0-0						
337	Thermoforming for Fabricating Lightweight Structural Composite Materials	148	30-40		CP				
358	Thermoplastic Repairs By Bonding With Induction Heating	148	30-40						
	PRIORITIZATION			**1**	**3**	**2**			

LEGEND:

U: Unit Replacement
C: Composites
I: Rust Inhibitors

R: Research
P: PIWG Action Item

N: Near Term
F: Far Term

Servicing **Sum Of Unique Severity Factors: 133**

ID:	Technology:	Score:	Risk/Cost:					
1	Multifunction Aircraft Ground Support System (MAGSS)	24	0-5			UP		
22	Self-Generating Nitrogen Through Hollow Fiber Membrane Technology	143	25-40	UP				
42	Pressure-Reducing Regulator with Bubble-Tight Sealing (Gas or Liquid)	12	15-20		AP			
129	A Single Gauge Versus an Instrument Cluster	16	20-25		AP			
244	Light-Emitting Sheets of Plastic for Aircraft	0	50-55		AP			
298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	10	90-95			UR		
350	Aircraft-Mounted Refueling Pump	0	0-0					
357	Integrated OBOGS / OBIGGS Module for Aircraft	179	25-30				UP	
	PRIORITIZATION				**3**	**1N**	**2**	**1F**

LEGEND:

U: Unit Replacement
A: Accessories
R: Research
P: PIWG Action Item

N: Near Term
F: Far Term

Auxiliary Lighting **Sum Of Unique Severity Factors: 110**

ID:	Technology:	Score:	Risk/Cost:						
1	Multifunction Aircraft Ground Support System (MAGSS)	171	0-5		UP				
27	Reduced Maintenance Batteries	21	70-80						
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	17	30-40	CP					
36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	17	30-40	CP					
43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet 100)	59	50-60				EP		
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	17	30-40	CP					
49	Digital Power Monitor for Ground AC/DC Power Systems (Logitek)	1	25-30						
78	Lithium Solid Polymer Electrolyte Batteries	6	70-80						
116	Blind Fastener Applies Self-Sealants	0	0-0						
118	Advanced Lead Acid Batteries	0	0-0						
129	A Single Gauge Versus an Instrument Cluster	6	20-25						
133	All-Plastic Battery	6	70-80						
136	High Efficiency Propulsion System	36	75-80				ER		
155	High Reliability Maintenance-Free Battery	6	70-80						
158	Super Lightweight Fuel Tank	1	50-55						
159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	34	15-20			LP			
168	Concrete Solar Cells as a DC Power Source at Remote Locations	3	50-65		UR				
178	Long-Life Solid State Arrays for DC Power Generation	3	50-65		UR				
188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	17	30-40	CP					
198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	17	30-40	CP					
201	Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches	18	0-5						
202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	17	30-40	CP					
227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	2	0-5						
233	Solar Power to Extend Battery Life (Solargizers)	6	15-20						
238	All-Plastic, Solid State Battery	6	70-80						
243	Computerized System to Track Limited-Life, On-Condition Components	64	15-20						
254	Heat Shrink Bar Code Labels on Identification Sleeves	3	0-5						
280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	17	30-40	CP					
285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	32	0-5			SP			
298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	171	0-5		UR		ER		
302	Split-Cycle Technology Engine	44	90-95				ER		
306	Composite Vehicle Structure	17	30-40	CP					
317	Lighter Cast-Iron Engine Blocks	7	35-40						

322	MagneStrap	34	15-20			LR		
330	Circuit Breaker Switch Panels	7	0-5					
334	Oil-Resistant Silicone	32	0-5			SP		
337	Thermoforming for Fabricating Lightweight Structural Composite Materials	17	30-40	CP				
346	Low Maintenance Battery System for Aircraft	6	70-80					
358	Thermoplastic Repairs By Bonding With Induction Heating	17	30-40	CP				
364	Two-Year Batteries for Aircraft	6	70-80					
	PRIORITIZATION			**2**		**1N**	**1F**	

LEGEND:

U: Unit Replacement
C: Composites
L: Lubricants
S: Seals
E: Engines

R: Research
P: PIWG Action Item

N: Near Term
F: Far Term

Misc In-Shop Equipment **Sum Of Unique Severity Factors: 98**

ID:	Technology:	Score:	Risk/Cost:						
26	Ice Blast	11	15-20		CP				
27	Reduced Maintenance Batteries	121	70-80	VP					
28	Carbon Dioxide Pellet Cleaning System	11	15-20		CP				
51	Non-Toxic Flashjet Coatings Removal Process for Aircraft	11	20-25		CP				
78	Lithium Solid Polymer Electrolyte Batteries	121	70-80	VP					
86	Active Noise Reduction (ANR) Headsets for Armored Vehicle Operators	3	15-20						
96	Noise Canceling Headsets (HMEC45-45KA/CA)	3	15-20						
118	Advanced Lead Acid Batteries	0	0-0						
133	All-Plastic Battery	121	70-80	VP					
144	Supersonic Gas-Liquid Cleaning System	0	0-0						
155	High Reliability Maintenance-Free Battery	121	70-80	VP					
158	Super Lightweight Fuel Tank	1	50-55						
175	Battery Checker and Log Device	39	15-20			EP			
233	Solar Power to Extend Battery Life (Solargizers)	121	15-20	VP		EP			
238	All-Plastic, Solid State Battery	121	70-80	VR					
310	Miniature Power Relays	6	5-10			EP			
325	Parts Cleaner	0	15-20						
326	Pipe-Cutting Machines (Mactech Inc., Red Wing, Minn.)	0	0-0						
330	Circuit Breaker Switch Panels	21	0-5			EP			
332	Portable Blind- Riveting Tool	0	0-0						
335	Torqueless Nut	0	0-0						
346	Low Maintenance Battery System for Aircraft	121	70-80	VP					
347	On-Board Engine Oil Analysis System for Aircraft	0	0-0						
364	Two-Year Batteries for Aircraft	121	70-80	VP					
	PRIORITIZATION			**1**	**1**	**1**			

LEGEND:

V: Batteries
C: Composites
E: Engines

R: Research
P: PIWG Action Item

N: Near Term
F: Far Term

Air Conditioner **Sum Of Unique Severity Factors: 94**

ID:	Technology:	Score:	Risk/Cost:						
1	Multifunction Aircraft Ground Support System (MAGSS)	151	0-5	UP					
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	51	30-40		CP				
36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	51	30-40		CP				
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	51	30-40		CP				
52	Long-Term, Salt Water-Displacing Corrosion Inhibitor for Aircraft	18	0-5			IP			
68	Steel-Like Material for Bleed Air Ducts (Inconel)	0	15-20						
70	Australian Fatigue Patching Technology for C-141 StarLifter	0	0-0						
93	Polyurethane Topcoats for Aircraft and Support Equipment	21	0-5			IP			
95	Self-Cooling Waterjet Cutting for Aircraft Sheet Metals and Composites	9	65-70						
98	Diffusional Coatings For Flight Hardware And Ground Support Equipment	21	50-55			IR			
105	Innovative Corrosion Inhibitor Compounds From Tobacco Extracts	0	0-0						
129	A Single Gauge Versus an Instrument Cluster	6	20-25						
132	Thermal Protection System	0	25-30						
136	High Efficiency Propulsion System	5	75-80						
158	Super Lightweight Fuel Tank	1	50-55						
159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	9	15-20						
188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	51	30-40		CP				
196	Tough Engineering Plastic Resins for Corrosion-Resistant Coatings	21	0-5			IP			
198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	51	30-40		CP				
202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	51	30-40		CP				
212	Liquid Flow-Through Cooling for Power Supplies	276	90-95				UR		
227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	16	0-5						
243	Computerized System to Track Limited-Life, On-Condition Components	104	15-20						
247	High Temperature Electronics (Up to 535 Deg C)	276	90-95				UR		
260	New Lightweight ECS Ducting Resists Crushing, Oils and Solvents	0	15-20						
268	Composite Repair Technology for Metallic Aircraft Structures	0	0-0						
279	High Performance Heat-Absorbing Material for Liquids or Solid Materials	276	90-95				UR		
280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	51	30-40		CP				
285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	12	0-5						
295	Lockable Worm Gear Hose Clamp - The Pintite SS	0	0-5						
298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	159	90-95	UR					

300	Portable Environmental Control System (PECS) for Air Cooling & Heating	159	0-5	UP					
302	Split-Cycle Technology Engine	7	90-95						
306	Composite Vehicle Structure	51	30-40		CP				
311	Heat-Activated Cooling Systems	0	0-0						
316	Flow-Through Ion Gun	21	50-55			IR			
317	Lighter Cast-Iron Engine Blocks	1	35-40						
322	MagneStrap	9	15-20						
330	Circuit Breaker Switch Panels	7	0-5						
334	Oil-Resistant Silicone	12	0-5						
337	Thermoforming for Fabricating Lightweight Structural Composite Materials	51	30-40		CP				
356	Multiple Integrated Power Unit (MIPU) For Aircraft	190	65-70				UR		
358	Thermoplastic Repairs By Bonding With Induction Heating	51	30-40		CP				
360	Immersion Phase-Change Cooling for Aircraft	276	90-95				UR		
	PRIORITIZATION			**1**	**2***	**2***	**3**		

LEGEND:

U: Unit Replacement
C: Composites
I: Rust Inhibitors

R: Research
P: PIWG Action Item

* To be done together

Trailer/Dolly

Sum Of Unique Severity Factors: 90

ID:	Technology:	Score:	Risk/Cost:					
10	Reconfigurable Ground Support Frame	35	25-30		UR			
14	Transportable Missile Storage Racks	10	15-20					
285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	37	0-5	SP				
334	Oil-Resistant Silicone	37	0-5	SP				
	PRIORITIZATION			**1N**	**1F**			

LEGEND:

U: Unit Replacement
S: Seals
R: Research
P: PIWG Action Item

N: Near Term
F: Far Term

Deployment ID:	Technology:	Sum Of Unique Severity Factors: Score:	84 Risk/Cost:					
1	Multifunction Aircraft Ground Support System (MAGSS)	30	20-25	FP				
10	Reconfigurable Ground Support Frame	9	25-30	FR				
14	Transportable Missile Storage Racks	3	15-20					
19	Clamshelter	6	25-30					SP
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	24	30-35				CP	
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	24	30-35				CP	
50	Portable Bar Code Printer for Warehouse Pallets (K2000)	12	0-5		IP			
58	SwRI's Smart Beacon Package to Locate Anything, Anywhere	21	50-55		IP			
62	Savi Asset Management and Transportation Management System	21	50-55		IP			
63	Helmet Mounted Display for USN Forklift Drivers	4	15-20			HR		
64	Relocatable, Expandable Shelters for US Army Aviation Maintenance	6	25-30					SP
84	Canadian Handheld Explosives Detector for Vehicle Inspections	4	15-20			HP		
176	Modular Aircraft Staging System - Maintenance Stands	20	15-20	FR				
177	Self-Propelled Helipad	1	50-55			HP		
180	Wristwatch-Size GPS Receivers for Embedded Applications	21	50-55		IR			
183	Scandinavian Bellyloader - Sliding Carpet Cargo Loading System	5	15-20			HP		
188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	24	30-35				CP	
189	Quick-Knockdown, Side-Loading Shipping Crates	0	0-0					
190	French-Made, Reusable, Collapsible Shipping Containers	6	0-5			HP		
194	MF1 Silicon Foam for Fire Blocking, and Thermal & Acoustic Insulation	4	5-15			HP		
197	RF-120 Thermal Composite Material	2	15-20			HP		
208	Fire-Retardant Kevlar Blankets with Silicon Coatings	2	15-20			HP		
212	Liquid Flow-Through Cooling for Power Supplies	6	90-95	FR				
213	Machinable, Noncorrosive Coating to Refurbish Aircraft Components	2	90-95					
215	LD-3-Sized Blast Resistant Luggage Container	2	40-45			HP		
216	Self-Sealing Fasteners for Anti-Leak Requirements	13	0-5					
220	DoD Acquisition of Commercial-Type Cargo Containers for CRAF Aircraft	17	25-30			HP		
222	In-Flight Location of Transports/Tankers and Crew & Cargo Status	9	25-30		IP			
226	New Thermoplastic Composite Cargolite for Cargo Containers	17	30-40			HP		
234	Asset Visibility - Improved Automated Logistics Tracking Systems	21	50-55		IP			
242	Quadrupole Resonance Technology for Plastic Explosives Detection	4	25-30			HP		
247	High Temperature Electronics (Up to 535 Deg C)	6	90-95	FR				
264	The Rubb Rapid Erect Building for Flightline Maintenance/Storage	6	25-30					SP

279	High Performance Heat-Absorbing Material for Liquids or Solid Materials	6	90-95	FR				
280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	24	30-40				CP	
288	Combat Track - Satellite Linked Logistics Tracking System	21	50-55		IP			
296	Nonflammable Foam-In-Place Insulation - Polyimide Materials	4	5-15			HP		
298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	30	90-95	FR				
306	Composite Vehicle Structure	24	30-35				CP	
309	Electric Vehicles	6	40-45					
331	Hydraulic-Fluid Hose	0	0-0					
341	Stressed Arch Hangars for Rapid, 100-Ft High Clear-Span Construction	6	25-30					SP
356	Multiple Integrated Power Unit (MIPU) For Aircraft	12	65-70	FR				
360	Immersion Phase-Change Cooling for Aircraft	6	90-95	FR				
	PRIORITIZATION			**1**	**2**	**3**	**4**	**5**

LEGEND:

F: Footprint
C: Composites
I: Information
H: Handling
S: Shelters

R: Research
P: PIWG Action Item

Environmental **Sum Of Unique Severity Factors: 53**

ID:	Technology:	Score:	Risk/Cost:						
12	Robotic Replenishment of Consumables	0	0-0						
18	Wash Rack Facility with Water Recycling	2	45-50	CP					
19	Clamshelter	4	25-30						
24	Whisper Wash Spray System	2	25-30	CP					
26	Ice Blast	20	15-20	CP					
27	Reduced Maintenance Batteries	26	70-80				VP		
28	Carbon Dioxide Pellet Cleaning System	20	15-20	CP					
51	Non-Toxic Flashjet Coatings Removal Process for Aircraft	20	15-20	CP					
64	Relocatable, Expandable Shelters for US Army Aviation Maintenance	4	25-30				VP		
78	Lithium Solid Polymer Electrolyte Batteries	26	70-80						
86	Active Noise Reduction (ANR) Headsets for Armored Vehicle Operators	6	15-20						
94	Pre-Takeoff Ice Detection System (HALO)	0	0-0						
96	Noise Canceling Headsets (HMEC45-45KA/CA)	6	15-20						
99	A Low Profile Cryogenic SCBA System With Personal Cooling And Whole-Body Protective Suit	21	40-45		SP				
106	All-Position Superconducting Magnetic Dewar For Dispensing Liquid Oxygen In Self-Contained Breathing Apparatus	0	0-0						
107	A Non-Polluting Electrochemical Paint Stripping Technology	20	50-55	CP					
108	Blackbody Photoreactor For Scrubbing Of Hazardous Waste	0	0-0						
114	New Auto Paint Cuts Solvent Emissions	14	0-5			TP			
118	Advanced Lead Acid Batteries	0	0-0						
128	Water Systems Impinge on CFC cleaning Methods	0	0-0						
133	All-Plastic Battery	26	70-80				VR		
134	Development of Alcohol Fueled Engines	0	0-0						
135	Multi-Objective Process Planing in Environmentally Conscious Manufacturing	0	0-0						
142	"Clean & Silent" Diesel Engines	2	15-20						
144	Supersonic Gas-Liquid Cleaning System	0	0-0						
147	Thermal Coating System	0	0-0						
155	High Reliability Maintenance-Free Battery	26	70-80				VP		
161	A New Life For Old Tires	0	0-0						
163	Recycled Rubber Material	0	0-0						
169	Electro-Optical Ice Detection System Using False-Color Imaging	0	0-0						
199	Zinc-Based Alloy Films for Highly Corrosion-Resistant Protection	20	40-45			TP			
230	Containerized Field Laundry with No Diesel Fuel Smell in Undershorts	0	0-0						
233	Solar Power to Extend Battery Life (Solargizers)	26	15-20				VP		
238	All-Plastic, Solid State Battery	26	70-80				VR		

258	Emergency Containment and Recovery System for Toxic Fluid Spills	12	40-45	CP					
264	The Rubb Rapid Erect Building for Flightline Maintenance/Storage	4	25-30						
269	Gas-Fired Infrared Heating Deicers for Commercial Aircraft	2	40-45						
293	Head-To-Toe Soldier Protective Ensemble	24	40-45		SP				
301	New Non-Volatile Parts Cleaner Developed By McDonnell Douglas Corp	62	25-30	CP					
309	Electric Vehicles	7	40-45						
341	Stressed Arch Hangars for Rapid, 100-Ft High Clear-Span Construction	4	25-30						
346	Low Maintenance Battery System for Aircraft	26	70-80				VP		
364	Two-Year Batteries for Aircraft	26	70-80				VP		
		PRIORITIZATION		**1**	**1**	**1**	**1**		

LEGEND:

C: Cleaning Systems
S: Suits
V: Batteries
T: Paints

R: Research
P: PIWG Action Item

Technology Prioritization By Most Severe Problems

LEGEND

P - For PIWG Action
R - For Research
CER - Comprehensive Engineering Redesign
IMA - For Item Manager Action

Items marked in the same column are to be treated as "exclusive OR"

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
254	9	40K Loader	**Most common problem is that it frequently fails to lift to platform level. Or if it does extend, it will not lower. Still has many hydraulic leaks.**				
789	(9)	40K Loader	**Hydraulic controls on 40K loader needs to be improved.**				
	152	Electrohydrostatic Actuation (EHA) System for Primary Flight Controls	154	25-30	R		
	40	Rare-Earth Magnet Direct Drive Servovalves (DDV), Electrically Controlled	154	25-30	R		
	255	New European Pallet/Container Loader (31K) for Commercial Transporters	84	25-30		P	
	243	Computerized System to Track Limited-Life, On-Condition Components	48	15-20			
	329	Powertrain Electronics	0	0-0			
	315	Horton-Global Series PTO Clutch	0	0-0			
300	9	-10 Air Conditioner	**They're losing expansion turbines due to water condensation in the oil; summer moisture is a problem here causing corrosion.**				
	212	Liquid Flow-Through Cooling for Power Supplies	276	90-95		R	
	360	Immersion Phase-Change Cooling for Aircraft	276	90-95		R	
	247	High Temperature Electronics (Up to 535 Deg C)	276	90-95		R	
	279	High Performance Heat-Absorbing Material for Liquids or Solid Materials	276	90-95		R	
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	190	65-70			R
	300	Portable Environmental Control System (PECS) for Air Cooling & Heating	159	0-5	P		
	243	Computerized System to Track Limited-Life, On-Condition Components	104	15-20			
87	8	-86 Generator Set	**Shutdown cable goes across the hot output terminals, which are connected to a panel. When the clamp breaks or the cable is pulled, the cable touches the backside of the panel and arcs. Fire emits from that area.**				
	282	Whisper Power Ground Power Unit From Hobart	276	10-15		P	
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	220	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	218	90-95			R
	1	Multifunction Aircraft Ground Support System (MAGSS)	211	15-20		P	
	227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	8	0-5	P		
911	8	-10 Air Conditioner	**When sloot air line clamp blows off, all plastic lines melt in compartment - maintainers have incorporated a wiggins fitting & install immediately on new units**				
313	(8)	-10 Air Conditioner	**Blasting lines can melt if air leaks. (plastic lines?)**				
1174	(8)	-10 Air Conditioner	**The -10D is built with all plastic lines. If one blows, the unit can reach temperatures of 400 to 500 degrees which melts all the lines.**				
1282	(8)	-10 Air Conditioner	**If clamps vibrate off sloots the plastic lines will melt if not caught right away.**				
1305	(8)	-10 Air Conditioner	**Replaced the stock clamps on the sloots with V band type clamps (approx $160 per clamp).**				

ID:	S.F.			Score:	Risk/Cost:	Priority: 1	2	3
	360	Immersion Phase-Change Cooling for Aircraft		276	90-95	CER		
	247	High Temperature Electronics (Up to 535 Deg C)		276	90-95			
	279	High Performance Heat-Absorbing Material for Liquids or Solid Materials		276	90-95			
	212	Liquid Flow-Through Cooling for Power Supplies		276	90-95			
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		190	65-70			
	300	Portable Environmental Control System (PECS) for Air Cooling & Heating		159	0-5			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		159	90-95			
	1	Multifunction Aircraft Ground Support System (MAGSS)		151	0-5			
	227	Heat- and Fire-Resistant Cable Covers for Wiring Harnesses		16	0-5		P	
	295	Lockable Worm Gear Hose Clamp - The Pintite SS		0	0-5			
28	**7**	**B-5 Stand**	**Hitch holdup latch doesn't work. Tongue falls on people and causes serious injury. Improper/weak spring mechanism.**					
	176	Modular Aircraft Staging System - Maintenance Stands		182	15-20	CER	P	
47	**7**	**Cabin Leakage Tester**	**When the unit is turned off, the unit always catches fire at the exhaust area (diesel engine). No matter what base or location, these units all exhibit the same exact discrepancies of catching on fire and erratic pressure control.**					
49	**(7)**	**Cabin Leakage Tester**	**Base has an electric unit, a gas unit and a diesel unit. Gas unit has outlived its life. Catches fire.**					
511	**(7)**	**Cabin Leakage Tester**	**Need to close exhaust cover to extinguish backfire on cabin pressure cart (I think).**					
513	**(7)**	**Cabin Leakage Tester**	**Unit sometimes catches on fire: NSN 4920-00-43-9397 Cabin Tester.**					
1037	**(7)**	**Cabin Leakage Tester**	**Several fires in exhaust area due to backfiring/post ignition, finally have to pull choke to shut it down & close exhaust door (Old models)**					
1347	**(7)**	**Cabin Leakage Tester**	**Older units sometimes catch on fire when shutdown (post ignition). Must choke it out. Newer units (with key) seem to work okay.**					
	34	Hybrid Gas/Powder Fire Extinguishing Agent (Halon-Free)		45	0-5	IMA		
76	**7**	**-86 Generator Set**	**Towbar latch fails and allows towbar to fall on people. They get severely injured on the head, back and feet. Wears out too quick. Mechanism is too small for the job it is trying to do. Needs a meatier latch**					
474	**(7)**	**-86 Generator Set**	**-86 tongue vibrates while towing and sometimes falls to the ground (considered a safety issue).**					
	282	Whisper Power Ground Power Unit From Hobart		276	10-15	CER		
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		220	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		218	90-95			
	1	Multifunction Aircraft Ground Support System (MAGSS)		211	15-20			
	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet		35	50-60			
78	**7**	**-86 Generator Set**	**After one week, water pumps leak around the shaft seal. Detroit-supplied pumps leak right out of the box (have made an in-shop tester to test them). Three QDRs submitted 1 year ago, but status unknown. Failures comes in batches.**					
	282	Whisper Power Ground Power Unit From Hobart		276	10-15			
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		220	65-70	IMA		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		218	90-95			

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
	1	Multifunction Aircraft Ground Support System (MAGSS)	211	15-20			
	243	Computerized System to Track Limited-Life, On-Condition Components	100	15-20			
	334	Oil-Resistant Silicone	58	0-5			
	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	58	0-5			
79	7	**-86 Generator Set**	**New radiators from base supply leak around the hose fittings. Must have them welded before installing them. Many are failing on the flightline.**				
	282	Whisper Power Ground Power Unit From Hobart	276	10-15			
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	220	65-70	IMA		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	218	90-95			
	1	Multifunction Aircraft Ground Support System (MAGSS)	211	15-20			
	243	Computerized System to Track Limited-Life, On-Condition Components	100	15-20			
83	7	**-86 Generator Set**	**Newer units are single bearing generators and are more unreliable. Results in dust intrusion, cracked seals and causes fields to crack. Failure difference of 10 to 1 between the old and newer units. Older units also had a covering on the back which helped.**				
84	(7)	**-86 Generator Set**	**In the newer single bearing units, the weight of the front half of generator rests on the main crank bearing, causing main bearing oil seals to go out. Can use double bearing part in the single bearing units**				
85	(7)	**-86 Generator Set**	**Can occasionally get the two bearing part from supply when they have them. When the bearing is issued, must order the special adapter plate and bolts to complete the installation. Often goes MICAP for the adapter plate and bolts.**				
	282	Whisper Power Ground Power Unit From Hobart	276	10-15			
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	220	65-70	IMA- Older Units work best		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	218	90-95	since bearing units are not		
	1	Multifunction Aircraft Ground Support System (MAGSS)	211	15-20	suitable substitutes.		
	243	Computerized System to Track Limited-Life, On-Condition Components	100	15-20	.		
	334	Oil-Resistant Silicone	58	0-5			
	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	58	0-5			
	187	Diamond-Coated Ceramic Ball Bearings	15	15-20			
	363	Superconducting Magnetic Bearings for Gas Turbine Engines	0	90-95			
	240	Hydrostatic Bearing Technologies (Liquid Bearings)	0	90-95			
	273	Non-Contact Magnetic Bearings for Gas Turbine Engines	0	90-95			
	318	Lead-Free Bearings	0	0-0			
88	7	**-86 Generator Set**	**Output cables are routed over the top of the generator and across the control panel. They chafe and wear against the bolts which hold the accessories to the top of the panel. Cables need more chafe padding due to vibration of diesel engine.**				
	282	Whisper Power Ground Power Unit From Hobart	276	10-15	CER-cable routing		
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	220	65-70			

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
298		Hepp Vapor Engine for a Family of Multifunction Support Equipment	218	90-95			
1		Multifunction Aircraft Ground Support System (MAGSS)	211	15-20			
227		Heat- and Fire-Resistant Cable Covers for Wiring Harnesses	8	0-5		P	
134	7	**H-1 Heater** **Fumes in the hot air output are overwhelming when used in a confined area (C-130 bay)**					
137	(7)	**H-1 Heater** **User wants maximum heat and turns unit up to 250-260 degrees. On shutdown, he doesn't allow for cool down. Heat exchangers crack as a result. User abuse. Maybe a training problem.**					
185		Carbon Foam Material for Insulation, High-Temp Filters and Engine Parts	133	50-55		P	
218		Maxi-Heat Portable Heater and Generator for Isolated Job Sites	128	15-20	P		
31		High-Purity Ceramics for High-Temp Strength and Corrosion Resistance	21	50-55			
160		New Device Removes Deadly Carbon Monoxide	14	50-55			
171		Novel Fiber Pad Connection for Attaching Heat Sink to Heat Source	0	0-0			
188	7	**NF-2D Floodlight** **SetVibration causes cracking in the back field section of generators. This separation allows the whole field to spin, breaking off the wires going to the diodes. Generators must be salvaged.**					
435	(7)	**NF-2D Floodlight Set** **Generators come apart and cracks.**					
879	(7)	**NF-2D Floodlight Set** **Engine/Generator 40 mils vibration - Problem was a marriage of a commercial diesel engine, DoD generator and isolator/mount system.**					
1		Multifunction Aircraft Ground Support System (MAGSS)	171	0-5	CER - Engine replacement		
298		Hepp Vapor Engine for a Family of Multifunction Support Equipment	171	0-5	in progress.		
243		Computerized System to Track Limited-Life, On-Condition Components	64	15-20			
43		Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet	59	50-60			
317		Lighter Cast-Iron Engine Blocks	7	35-40			
254		Heat Shrink Bar Code Labels on Identification Sleeves	3	0-5			
168		Concrete Solar Cells as a DC Power Source at Remote Locations	3	50-65			
178		Long-Life Solid State Arrays for DC Power Generation	3	50-65			
190	7	**NF-2D Floodlight Set** **Nutplates do not remain captive. Have to remove them before they fall off inside. They are not doing their job.**					
298		Hepp Vapor Engine for a Family of Multifunction Support Equipment	171	0-5	CER-needs a rivet.		
1		Multifunction Aircraft Ground Support System (MAGSS)	171	0-5			
280		Rigid-Rod Polymer Plastics for Structural Metal Replacements	17	30-40			
306		Composite Vehicle Structure	17	30-40			
198		Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	17	30-40			
337		Thermoforming for Fabricating Lightweight Structural Composite Materials	17	30-40			
358		Thermoplastic Repairs By Bonding With Induction Heating	17	30-40			
188		New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	17	30-40			

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts		17	30-40			
36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material		17	30-40			
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)		17	30-40			
202	BFGoodrich's TempRite Low-Combustibility Thermoplastics		17	30-40			
168	Concrete Solar Cells as a DC Power Source at Remote Locations		3	50-65			
178	Long-Life Solid State Arrays for DC Power Generation		3	50-65			
116	Blind Fastener Applies Self-Sealants		0	0-0			
213	7	**SE in General**	**Eliminate all Zeus fasteners on every piece of support equipment. They are a FOD hazard. Particularly on jammers.**				
690	(7)	**SE in General**	**FOD is a general problem.**				
123	Polyester Material for Fasteners		24	0-5	R	(Have not found	
283	Self-Locking All-Metal Fastener		24	0-5	R	a good replace-	
191	Advanced Self-Locking Fastener With Reusable Nut Sleeve & Lock Ring		24	0-5	R	ment for Zeus	
195	DUAL-LOK Self-Locking Fastener for High-Temperature Applications		24	0-5	R	fasteners with	
53	Viscous Resin Thread-Locking Compound (Vibra-Tite)		24	0-5	R	quick access.)	
192	Omni-Lok Self-Locking Fastener for High-Temperature Applications		24	0-5	R		
228	Molded Urethane Flightline Chocks		0	0-5	R		
32	Nonmetallic Aircraft Fasteners with Superior Pull-Out Strength		0	0-0			
242	7	**MC-7 Compressor**	**Used with fuel cell carts, but unit shoots a lot of water out of the line, which damages ram air pumps and VMPs. When the water freezes, the external tanks won't pressurize. Needs a water separator or dehydrator.**				
422	(7)	**MC-7 Compressor**	**MC-7 needs filter to take water out of the air.**				
298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		168	90-95	CER-	Needs a water	
1	Multifunction Aircraft Ground Support System (MAGSS)		160	20-25		separator	
185	Carbon Foam Material for Insulation, High-Temp Filters and Engine Parts		12	75-80			
314	Filter/Regulator/Lubricator (FRL) Systems		0	0-0			
305	Compressed-Air Filters by IMI Norgren Inc., Littleton, Colo.		0	0-0			
246	7	**-10 Air Conditioner**	**Maximum cooling output of 55 degrees on a hot day. Should be able to cool to 40 degrees**				
250	(7)	**-10 Air Conditioner**	**User problem between the C and D model. The user will pull the combined flow to get more volume. This will heat the air on the C model. User thinks the unit is inop, although it is not. Training problem.**				
310	(7)	**-10 Air Conditioner**	**Does not provide adequate cooling for summer operations.**				
322	(7)	**-10 Air Conditioner**	**Doesn't put out enough air in either hot or cold weather; the -85 is OK.**				
1089	(7)	**-10 Air Conditioner**	**Approximately eight out of ten -10s do not work correctly. The ECS light stays on due to low pressure.**				
1132	(7)	**-10 Air Conditioner**	**Unit only provides enough air 10 percent of the time.**				
247	High Temperature Electronics (Up to 535 Deg C)		276	90-95			
212	Liquid Flow-Through Cooling for Power Supplies		276	90-95			
279	High Performance Heat-Absorbing Material for Liquids or Solid Materials		276	90-95			

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
	360	Immersion Phase-Change Cooling for Aircraft	276	90-95			
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	190	65-70			
	300	Portable Environmental Control System (PECS) for Air Cooling & Heating	159	0-5	P		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	159	90-95			R
	1	Multifunction Aircraft Ground Support System (MAGSS)	151	0-5		CER	Increase
	311	Heat-Activated Cooling Systems	0	0-0	Volume and add separator.		
247	**7**	**-10 Air Conditioner** **Due to high humidity, the coalescent bag freezes up in the C-10D. Needs a screen and a drain in the air stream before the bag to break down the moisture to smaller pieces to prevent clogging of bag.**					
249	**(7)**	**-10 Air Conditioner** **One maintainer thought the C unit produced more water than the D model in Saudi Arabia. Excess water would enter in the aircraft electronics. Didn't have drain on unit. Can avoid problems by bringing aircraft to ambient temperature.**					
1090	**(7)**	**-10 Air Conditioner** **There is too much moisture in the -10 air.**					
	212	Liquid Flow-Through Cooling for Power Supplies	276	90-95		CER	
	360	Immersion Phase-Change Cooling for Aircraft	276	90-95			
	247	High Temperature Electronics (Up to 535 Deg C)	276	90-95			
	279	High Performance Heat-Absorbing Material for Liquids or Solid Materials	276	90-95			
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	190	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	159	90-95			
	300	Portable Environmental Control System (PECS) for Air Cooling & Heating	159	0-5	P		
	1	Multifunction Aircraft Ground Support System (MAGSS)	151	0-5			R
	311	Heat-Activated Cooling Systems	0	0-0			
248	**7**	**-10 Air Conditioner** **The C-10D unit doesn't handle very much air pressure, particularly in wintertime when air is heavier. Supposed to handle up to 45, but lower pressures can blow the bleed air sloot off on the inside.**					
	212	Liquid Flow-Through Cooling for Power Supplies	276	90-95		CER	Better
	279	High Performance Heat-Absorbing Material for Liquids or Solid Materials	276	90-95	Materials and Clamping		
	360	Immersion Phase-Change Cooling for Aircraft	276	90-95			
	247	High Temperature Electronics (Up to 535 Deg C)	276	90-95			
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	190	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	159	90-95			
	300	Portable Environmental Control System (PECS) for Air Cooling & Heating	159	0-5	P		
	1	Multifunction Aircraft Ground Support System (MAGSS)	151	0-5			R
261	**7**	**-85 Generator Set (GPGS)** **Center bar on -85 hoses fall off and gets lost.**					
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	220	65-70	CER		
309	**7**	**-10 Air Conditioner** **Hose not rugged; blows out if bent (same hose on all carts, lose an average of a hose a day).**					

ID:	S.F.			Score:	Risk/Cost:	Priority: 1	2	3
308	(7)	-10 Air Conditioner	**Tabs break off connectors from being dropped.**					
312	(7)	-10 Air Conditioner	**Potential safety problem; turning on the pressure to the C-10 could blow something.**					
319	(7)	-10 Air Conditioner	**Air conditioners are difficult to hook up because of damage (large aluminum rings get knocked out of round and ratchets are damaged).**					
1283	(7)	-10 Air Conditioner	**Ducts need to be made to handle higher temperatures and some abuse.**					
	212	Liquid Flow-Through Cooling for Power Supplies		276	90-95	CER		
	279	High Performance Heat-Absorbing Material for Liquids or Solid Materials		276	90-95			
	247	High Temperature Electronics (Up to 535 Deg C)		276	90-95			
	360	Immersion Phase-Change Cooling for Aircraft		276	90-95			
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		190	65-70			
	300	Portable Environmental Control System (PECS) for Air Cooling & Heating		159	0-5			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		159	90-95			
	1	Multifunction Aircraft Ground Support System (MAGSS)		151	0-5			
	68	Steel-Like Material for Bleed Air Ducts (Inconel)		0	15-20			
	260	New Lightweight ECS Ducting Resists Crushing, Oils and Solvents		0	15-20			
320	7	-10 Air Conditioner	**Very unreliable, with pressure as the prime problem (15C's and F111's). The only difference in pressure is when the ICS is on/off.**					
	360	Immersion Phase-Change Cooling for Aircraft		276	90-95		R	
	212	Liquid Flow-Through Cooling for Power Supplies		276	90-95		R	
	279	High Performance Heat-Absorbing Material for Liquids or Solid Materials		276	90-95		R	
	247	High Temperature Electronics (Up to 535 Deg C)		276	90-95		R	
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		190	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		159	90-95			
	300	Portable Environmental Control System (PECS) for Air Cooling & Heating		159	0-5	P		
	1	Multifunction Aircraft Ground Support System (MAGSS)		151	0-5			R
361	7	MJ2 Mule	**Need to spring load or better latch the tow bar on the mules.**					
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		209	90-95	CER-Better latch		
	1	Multifunction Aircraft Ground Support System (MAGSS)		209	25-30			
	299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical		63	10-15			
417	7	MC-2A Compressor	**Have fasteners that vibrate off (supposed to be captive (quarter turns) but vibrate off).**					
1109	(7)	MC-2A Compressor	**The housing on the Davey Lo PACs makes for good accessibility but has too many fasteners which could create a FOD hazard. Consider use of a fiberglass housing. The sheet metal that is currently used is too thin and has a tendency to crack.**					
1308	(7)	MC-2A Compressor	**Zeus-type fasteners on doors are a FOD hazard.**					
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		168	90-95			

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
	1	Multifunction Aircraft Ground Support System (MAGSS)	160	20-25			
	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	102	30-40	P		
	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	102	30-40	P		
	306	Composite Vehicle Structure	102	30-40	P		
	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	102	30-40	P		
	358	Thermoplastic Repairs By Bonding With Induction Heating	102	30-40	P		
	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	102	30-40	P		
	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	102	30-40	P		
	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	102	30-40	P		
	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	102	30-40	P		
	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	102	30-40	P		
	299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical	71	10-15			
	241	Glass-Epoxy-Aluminum Composite for Bonded Repairs	21	25-30			
451	7	**MJ-1 Jammer**	**Bottom cover comes loose and picks up debris like a shovel; fix is to get rid of bottom cover.**				
	297	RAZ and miniRAZ Munitions Handling Trolleys	252	0-5	CER-Fix or remove.		
	353	Built-In Cable Load Boxes/Drums for Aircraft	46	40-45			
	87	Trapeze Launcher Actuator Assembly for the F-22 Next Generation Fighter	46	40-45			
	306	Composite Vehicle Structure	18	30-40			
	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	18	30-40			
	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	18	30-40			
	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	18	30-40			
	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	12	30-40			
	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	12	30-40			
	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	12	30-40			
	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	12	30-40			
	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	12	30-40			
	358	Thermoplastic Repairs By Bonding With Induction Heating	12	30-40			
452	7	**MJ-1 Jammer**	**J1 travel bar always losing bolts used to secure it (uses nut, washer and cotter pin).**				
968	(7)	**MJ-1 Jammer**	**Travel bar breaks off - FOD problem**				
1131	(7)	**MJ-1 Jammer**	**The travel bar is missing hardware all the time. The MOLT (MHU-194) design is better.**				
	297	RAZ and miniRAZ Munitions Handling Trolleys	252	0-5	CER-Hardware		

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
	87	Trapeze Launcher Actuator Assembly for the F-22 Next Generation Fighter	46	40-45		IMA	
	353	Built-In Cable Load Boxes/Drums for Aircraft	46	40-45			
588	7	**Maintenance Stands (General)** **Loose nuts and bolts on stands cause FOD problems.**					
	176	Modular Aircraft Staging System - Maintenance Stands	182	15-20		P	
	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	164	30-40	CER-Correct hardware.		
	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	148	30-40			R
	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	148	30-40			R
	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	148	30-40			R
	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	148	30-40			R
	358	Thermoplastic Repairs By Bonding With Induction Heating	148	30-40			R
	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	148	30-40			R
	306	Composite Vehicle Structure	148	30-40			R
	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	148	30-40			R
	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	148	30-40			R
	335	Torqueless Nut	0	0-0			
638	7	**UALS**	**Jamming is the biggest problem and it breaks parts. Appears to be connected with gear timing (not quite in time when the shell is handed off).**				
647	(7)	**UALS**	**Jams regularly and they end up hand loading the ammunition.**				
651	(7)	**UALS**	**Air Force didn't buy dummy ammo (jamming/tearing up shells).**				
652	(7)	**UALS**	**F-15 gun system jams on loading.**				
846	(7)	**UALS**	**Jamming causes: PGU-27 round, goes in a nose up attitude (CG problem) - Jamming in gear mesh area thus causing parts to break.**				
1047	(7)	**UALS**	**Numerous jams due to timing - TCTO coming out to cure 50% of jams (slow coming), armament has implemented belt rerouting with great improvement.**				
1116	(7)	**UALS**	**PGU-27 ammo must be loaded manually due to the round's nose weight. Many instances where the case has been gouged causing loose powder. PGU-27 ammo has been in service about one year...used M-55 series prior to that.**				
1118	(7)	**UALS**	**Reportedly, personnel can't adjust the UALS properly because the USAF never bought dummy ammo. (The Navy did.)**				
1358	(7)	**UALS**	**Belt twist to make UALS compatible with F-16 causes timing problems between the drum and loader head. TCTO says to put twist between head and drum. New TCTO due out soon should cut down on half the jams.**				
	307	Composite Gears	45	15-20	IMA		
716	7	**C-1 Stand**	**FOD: maintenance a problem; C1 is small and used most frequently, thus it's biggest problem.**				
	176	Modular Aircraft Staging System - Maintenance Stands	182	15-20		P	
	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	164	30-40	CER-Hardware		
	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	148	30-40			R
	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	148	30-40			R

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
280		Rigid-Rod Polymer Plastics for Structural Metal Replacements	148	30-40			R
306		Composite Vehicle Structure	148	30-40			R
202		BFGoodrich's TempRite Low-Combustibility Thermoplastics	148	30-40			R
188		New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	148	30-40			R
36		Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	148	30-40			R
35		Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	148	30-40			R
358		Thermoplastic Repairs By Bonding With Induction Heating	148	30-40			R
949	**7**	**MC-2A Compressor New units, plastic fuel tanks are cracking**					
1310	**(7)**	**MC-2A Compressor New plastic fuel tank cracks.**					
298		Hepp Vapor Engine for a Family of Multifunction Support Equipment	168	90-95	CER-Use steel tanks.		
1		Multifunction Aircraft Ground Support System (MAGSS)	160	20-25			
299		Multifunction Unit for Hydraulics, Compressed Air & DC Electrical	71	10-15			
158		Super Lightweight Fuel Tank	1	50-55			
993	**7**	**C-1 Stand** **Support legs breaking & bolts falling off - FOD problem (see below)**					
994	**(7)**	**C-1 Stand** **AGE maintainers have been directed by Branch Chief to install self locking nuts on steps & platform**					
1323	**(7)**	**C-1 Stand** **Support legs crack and always require welding. Bolts from steps and cross beams fall out (FOD).**					
176		Modular Aircraft Staging System - Maintenance Stands	182	15-20		P	
44		Low Cost Composite Advances for Aircraft Structures (Graphlite)	164	30-40	CER-Hardware		
188		New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	148	30-40			R
35		Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	148	30-40			R
358		Thermoplastic Repairs By Bonding With Induction Heating	148	30-40			R
280		Rigid-Rod Polymer Plastics for Structural Metal Replacements	148	30-40			R
337		Thermoforming for Fabricating Lightweight Structural Composite Materials	148	30-40			R
202		BFGoodrich's TempRite Low-Combustibility Thermoplastics	148	30-40			R
198		Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	148	30-40			R
36		Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	148	30-40			R
306		Composite Vehicle Structure	148	30-40			R
43		Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet	37	50-60			
335		Torqueless Nut	0	0-0			
1061	**7**	**UALS** **Flex drive that manually turns the gun sys remotely, (4) have come apart violently and have injured several troops (personally saw a gash from nose to lip)**					
653	**(7)**	**UALS** **UALS flex drive for ammo cycle slips out of the socket and hits you in the face.**					
1360	**(7)**	**UALS** **Have had four flex drives come apart (cracks at socket). Dangerous - parts can hit face. May need lock pin or something.**					
43		Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet	73	50-60	IMA		

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
1080	7	**-10 Air Conditioner** **Valve E-7 (-10D) has poor reliability. The rubber diaphragm wears out and can't be ordered separately even** though it is easy to replace. The valve cost is in excess of $800.					
	212	Liquid Flow-Through Cooling for Power Supplies	276	90-95	IMA-Review SMR Code.		
	360	Immersion Phase-Change Cooling for Aircraft	276	90-95		CER-Valve	
	247	High Temperature Electronics (Up to 535 Deg C)	276	90-95			
	279	High Performance Heat-Absorbing Material for Liquids or Solid Materials	276	90-95			
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	190	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	159	90-95			
	300	Portable Environmental Control System (PECS) for Air Cooling & Heating	159	0-5			P
	1	Multifunction Aircraft Ground Support System (MAGSS)	151	0-5			
	243	Computerized System to Track Limited-Life, On-Condition Components	104	15-20			
1110	7	**MC-7 Compressor** **The housing on the Davey Lo PACs makes for good accessibility but has too many fasteners which could create a FOD hazard. Consider use of a fiberglass housing. The sheet metal that is currently used is too thin and has a tendency to crack.**					
	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics	102	30-40	P		
	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	102	30-40	P		
	358	Thermoplastic Repairs By Bonding With Induction Heating	102	30-40	P		
	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	102	30-40	P		
	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	102	30-40	P		
	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	102	30-40	P		
	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	102	30-40	P		
	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	102	30-40	P		
	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	102	30-40	P		
	306	Composite Vehicle Structure	102	30-40	P		
	241	Glass-Epoxy-Aluminum Composite for Bonded Repairs	21	25-30			
	70	Australian Fatigue Patching Technology for C-141 StarLifter	0	0-0			
	268	Composite Repair Technology for Metallic Aircraft Structures	0	0-0			
1150	7	**MC-7 Compressor** **Fuel tanks on Davey units tend to crack and leak due to vibration.**					
	241	Glass-Epoxy-Aluminum Composite for Bonded Repairs	21	25-30	CER-Use steel or redesign.		
	158	Super Lightweight Fuel Tank	1	50-55			
1418	7	**SE in General** **Reliability (Loose and Missing Fasteners): Numerous instances of nutplates breaking or falling off, too many safety-wired components, troops constantly cut hands/arms on safety wire, Zeus fasteners are a FOD hazard - particularly on jammers, fasteners vibrate off, maintenance stands have loose/missing bolts on**					

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
		steps that fall off.					
	191	Advanced Self-Locking Fastener With Reusable Nut Sleeve & Lock Ring	24	0-5	R		
	123	Polyester Material for Fasteners	24	0-5	R		
	283	Self-Locking All-Metal Fastener	24	0-5	R		
	195	DUAL-LOK Self-Locking Fastener for High-Temperature Applications	24	0-5	R		
	192	Omni-Lok Self-Locking Fastener for High-Temperature Applications	24	0-5	R		
	53	Viscous Resin Thread-Locking Compound (Vibra-Tite)	24	0-5	R		
	284	Self-Locking Set Screws	0	0-0			
45	**6**	**Cabin Leakage Tester**	**Unit is supposed to pressurize the aircraft slowly, but at idle it often jumps to high pressure immediately**				
46	**(6)**	**Cabin Leakage Tester**	**Unit is supposed to depressurize the aircraft slowly, but it often drops the pressure immediately with the possibility of damaging the cabin pressure regulator on the aircraft**				
500	**(6)**	**Cabin Leakage Tester**	**Leak testers tend to leak themselves.**				
1038	**(6)**	**Cabin Leakage Tester**	**Sporadic relief valve failures (New Gas model)**				
	302	Split-Cycle Technology Engine	49	90-95	IMA		
	136	High Efficiency Propulsion System	41	75-80			
	216	Self-Sealing Fasteners for Anti-Leak Requirements	24	0-5			
	246	Ceramic Capacitive Sensing Technology - Bleed Air Pressure Sensor	0	15-20			
74	**6**	**-86 Generator Set**	**Fenders are too heavy for the bolts that are used. Fenders will fall off when towing the unit. When hit by a tow tractor, fenders didn't dent but bolts broke and fell to the ground.**				
480	**(6)**	**-86 Generator Set**	**Fenders fall off.**				
	282	Whisper Power Ground Power Unit From Hobart	276	10-15	CER-Verify hardware.		
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	220	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	218	90-95			
	1	Multifunction Aircraft Ground Support System (MAGSS)	211	15-20			
	198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics	57	30-40		R	
	337	Thermoforming for Fabricating Lightweight Structural Composite Materials	57	30-40		R	
	35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts	57	30-40		R	
	188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials	57	30-40		R	
	280	Rigid-Rod Polymer Plastics for Structural Metal Replacements	57	30-40		R	
	36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material	57	30-40		R	
	306	Composite Vehicle Structure	57	30-40		R	
	44	Low Cost Composite Advances for Aircraft Structures (Graphlite)	57	30-40		R	
	358	Thermoplastic Repairs By Bonding With Induction Heating	57	30-40		R	

ID:	S.F.			Score:	Risk/Cost:	Priority: 1	2	3
	202	BFGoodrich's TempRite Low-Combustibility Thermoplastics		57	30-40		R	
	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet		35	50-60			
	70	Australian Fatigue Patching Technology for C-141 StarLifter		0	0-0			
	268	Composite Repair Technology for Metallic Aircraft Structures		0	0-0			
89	**6**	**-86 Generator Set**	**Non-metallic fuel tanks on the -86 constantly leak at the top.**					
	282	Whisper Power Ground Power Unit From Hobart		276	10-15	CER-Use steel.		
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		220	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		218	90-95			
	1	Multifunction Aircraft Ground Support System (MAGSS)		211	15-20			
	158	Super Lightweight Fuel Tank		6	50-55			
90	**6**	**-86 Generator Set**	**The fuel pick-up line was sucking up the bottom of the tank and cutting off the fuel flow.**					
	282	Whisper Power Ground Power Unit From Hobart		276	10-15	CER-Use steel tank.		
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		220	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		218	90-95			
	1	Multifunction Aircraft Ground Support System (MAGSS)		211	15-20			
102	**6**	**MJ2 Mule**	**Too many mules leak, even before they are hooked up to the aircraft. Happens too often. Leaks are considered a Hazmat incident, which must be mopped up with special rags, creating even more of a Hazmat waste disposal problem.**					
333	**(6)**	**MJ2 Mule**	**Hydraulic hookup has a sealing problem which is inconsistent, sometimes no leak at other times a heavy leak.**					
350	**(6)**	**MJ2 Mule**	**Mule is messiest to hook up.**					
359	**(6)**	**MJ2 Mule**	**Hydraulic units leak and drip.**					
1005	**(6)**	**MJ2 Mule**	**Safety problem - Leaks hydraulic fluid on user**					
	1	Multifunction Aircraft Ground Support System (MAGSS)		209	25-30	IMA		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		209	90-95			
	299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical		63	10-15			
144	**6**	**MC-2A Compressor**	**Manufacturer's switches faulty (ones with a tall throw) due to corrosion from water intrusion. In years past, the glow plug switch next to the fuel filter would short out due to corrosion and the unit would catch on fire.**					
146	**(6)**	**MC-2A Compressor**	**Unit has a history of setting itself on fire.**					
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		168	90-95			
	1	Multifunction Aircraft Ground Support System (MAGSS)		160	20-25			
	299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical		71	10-15			
	302	Split-Cycle Technology Engine		53	75-80			
	136	High Efficiency Propulsion System		53	75-80			
	34	Hybrid Gas/Powder Fire Extinguishing Agent (Halon-Free)		39	0-5			

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
	201	Rubber Sealing Boots for Toggle, Pushbutton and Rotary Shaft Switches	37	0-5	P		
	330	Circuit Breaker Switch Panels	29	0-5			
145	6	**MC-2A Compressor Voltage regulator shorts out and disintegrates. This also burns up all of the attaching wires. Unit nearly** catches on fire.					
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	168	90-95		CER-Hardware	
	1	Multifunction Aircraft Ground Support System (MAGSS)	160	20-25			
	299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical	71	10-15			
	136	High Efficiency Propulsion System	53	75-80			
	302	Split-Cycle Technology Engine	53	75-80			
	34	Hybrid Gas/Powder Fire Extinguishing Agent (Halon-Free)	39	0-5			
	330	Circuit Breaker Switch Panels	29	0-5	P		
153	6	**MC-2A Compressor On newer units, sheet metal control panel doors hinge downward and people often walk into them and get ripped up. Would be better for them to hinge upward like older units.**					
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	168	90-95	CER-Redesign hinge.		
	1	Multifunction Aircraft Ground Support System (MAGSS)	160	20-25			
	299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical	71	10-15			
159	6	**MJ-1 Jammer Exhaust system is constantly cracking from the elbow out. The engine is shock-mounted while the exhaust pipe is stationary frame-mounted. Problems caused by too much movement. Plus one mount goes from the engine to the exhaust pipe and constantly breaks**					
160	(6)	**MJ-1 Jammer Exhaust system is poorly mounted, which cracks under flexing. Exhaust leaks are not permitted on munitions handling equipment. Flexible tubing was used as a fix but didn't work. Will try rubber mounting the bracket next time.**					
163	(6)	**MJ-1 Jammer Exhaust U-bolt mount seems to have a weak weld, even on the ones coming in from Base Supply. Not enough weld penetration and break occurs at the weld. Stronger material needed also. Flex portion also needed beyond U-bolt position.**					
464	(6)	**MJ-1 Jammer Jammers MJ-1 exhaust cracks.**					
969	(6)	**MJ-1 Jammer Exhaust brackets, at U bolt, crack constantly - Engine is shock mounted vs exhaust pipe solid frame mounted - Problem caused by too much movement thus vibration.**					
1176	(6)	**MJ-1 Jammer Experiences many exhaust cracking problems. The muffler is mounted to the chassis and the rest of the exhaust system vibrates too much.**					
1367	(6)	**MJ-1 Jammer Exhausts crack at U-bolts. Weld them two times, then replace them.**					
	297	RAZ and miniRAZ Munitions Handling Trolleys	252	0-5	CER-Shock mount.		
	309	Electric Vehicles	195	40-45			
	87	Trapeze Launcher Actuator Assembly for the F-22 Next Generation Fighter	46	40-45			
	353	Built-In Cable Load Boxes/Drums for Aircraft	46	40-45			
	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet	44	50-60		P	
	68	Steel-Like Material for Bleed Air Ducts (Inconel)	0	15-20			
	260	New Lightweight ECS Ducting Resists Crushing, Oils and Solvents	0	15-20			
	171	Novel Fiber Pad Connection for Attaching Heat Sink to Heat Source	0	0-0			
164	6	**MJ-1 Jammer Many engine starting problems in the summer time due to solenoid being located in a high heat area. Many**					

ID:	S.F.		Priority:				
			Score:	Risk/Cost:	1	2	3
			fuses blow. A trial fix worked by remotely mounting an external solenoid next to the battery instead of on the starter. A heat shield would help also.				
165	(6)	MJ-1 Jammer	Using preheat in wintertime causes the solenoid to stick. Then fuses to blow when the master switch is turned.				
447	(6)	MJ-1 Jammer	J1: Stray voltage blows fuses, would prefer circuit breakers; also fuse is non-standard; have made such a request but was not authorized because they felt the problem causing the fuses to blow should be fixed.				
448	(6)	MJ-1 Jammer	J1 and J4's are hard on fuses (20 amps); blow when they try to start; other recommendation is to have spare fuses available on the vehicle.				
456	(6)	MJ-1 Jammer	They continually blow fuses which they contribute to the glow plug circuit.				
457	(6)	MJ-1 Jammer	MJ-1 starter too small for unit.				
462	(6)	MJ-1 Jammer	MJ1 - burning out starters - need more robust starter.				
465	(6)	MJ-1 Jammer	Move starter solenoid near battery box away from heat.				
852	(6)	MJ-1 Jammer	Blow fuses constantly, engineers think problem is in glow plug circuit (guessing) - Not doing anything about problem, don't believe user, i.e., engineers think user is exaggerating to justify correcting problem				
965	(6)	MJ-1 Jammer	No start hot days & fuses blow at start				
966	(6)	MJ-1 Jammer	Diagnosis - starter solenoid, during hot engine starts, doesn't close & thus overloads system causing blown fuses/dead batteries - Test fix (PAFB) was to remotely locate starter solenoid in battery box (away from engine heat) with no further problems				
972	(6)	MJ-1 Jammer	Electric fuel pumps have been disabled due to large amperage draw (blows fuses)				
1175	(6)	MJ-1 Jammer	Numerous starting solenoids have gone bad.				
1252	(6)	MJ-1 Jammer	The 20 amp fuse blows more often in the heat. Would like to see circuit breaker.				
1253	(6)	MJ-1 Jammer	Would like to see the starter solenoid placed externally like on Fords.				
1254	(6)	MJ-1 Jammer	If the electric fuel pump is turned on the 20 amp fuse is likely to blow. Pump is switched on separately.				
	297	RAZ and miniRAZ Munitions Handling Trolleys		252	0-5		P	
	309	Electric Vehicles		195	40-45	CER-Relocate and protect	
	87	Trapeze Launcher Actuator Assembly for the F-22 Next Generation Fighter		46	40-45	problem component.	
	353	Built-In Cable Load Boxes/Drums for Aircraft		46	40-45		
	330	Circuit Breaker Switch Panels		46	0-5		P
176	6	MJ-4 Jammer	Jump starts often blow the fuses. Circuit breakers would be helpful.				
	297	RAZ and miniRAZ Munitions Handling Trolleys		252	0-5		P	
	309	Electric Vehicles		195	40-45		
	87	Trapeze Launcher Actuator Assembly for the F-22 Next Generation Fighter		46	40-45		
	353	Built-In Cable Load Boxes/Drums for Aircraft		46	40-45		
	330	Circuit Breaker Switch Panels		46	0-5	P	
186	6	NF-2D Floodlight Set	Bad engine design as push rods criss-cross and rub against each other. Resultant metal wear causes rods to snap. Repair also requires new heads and pistons. Local vendors are vital to support NF-2s. ACC has a retrofit engine and generator kit forthcoming.				
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		171	0-5	IMA-Engine replacement in	
	1	Multifunction Aircraft Ground Support System (MAGSS)		171	0-5	progress.	
	243	Computerized System to Track Limited-Life, On-Condition Components		64	15-20		
	302	Split-Cycle Technology Engine		44	90-95		
	136	High Efficiency Propulsion System		36	75-80		
	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment		34	15-20		

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
	322	MagneStrap	34	15-20			
	178	Long-Life Solid State Arrays for DC Power Generation	3	50-65			
	168	Concrete Solar Cells as a DC Power Source at Remote Locations	3	50-65			
187	**6**	**NF-2D Floodlight Set**	**DC voltage regulators constantly short out and fail. Suspect bad supply source. This also causes batteries to fail, and units always require jump starting on the flightline.**				
1027	**(6)**	**NF-2D Floodlight Set**	**Voltage regulator failure rate is about one per month, even with incorporation of shock mount modification & RTV for sealing.**				
1214	**(6)**	**NF-2D Floodlight Set**	**AC voltage regulators are no good and are no longer being produced. Regulators that are fresh out of the box from supply may last one hour, one day or not work at all.**				
1234	**(6)**	**NF-2D Floodlight Set**	**Put rubber shock mounts on voltage regulators and prevented water intrusion...fixed many of the problems.**				
1373	**(6)**	**NF-2D Floodlight Set**	**Voltage regulators are replaced once a month even though they are on shock mounts and sealed with RTV.**				
	1	Multifunction Aircraft Ground Support System (MAGSS)	171	0-5	IMA-Continue engine		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	171	0-5	replacement.		
	243	Computerized System to Track Limited-Life, On-Condition Components	64	15-20	-Supplier failure		
	27	Reduced Maintenance Batteries	21	70-80	analysis.		
	178	Long-Life Solid State Arrays for DC Power Generation	3	50-65			
	168	Concrete Solar Cells as a DC Power Source at Remote Locations	3	50-65			
	49	Digital Power Monitor for Ground AC/DC Power Systems (Logitek)	1	25-30			
197	**6**	**Universal Towbar**	**Sometimes the crank handle for the adjustment of the towbar wheels breaks off, which takes the entire towbar out of service.**				
	223	Douglas-Kalmer TBL-280 Towbarless Aircraft Tug	64	25-30			
	294	Electrically-Powered Aircraft Towing Mechanism	64	25-30			
	21	U-Shaped Tow Vehicle	64	25-30			
	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet	43	50-60	P		
226	**6**	**MA-1A Start Cart**	**Units frequently flame out or shoots out fire. -95 is the scheduled replacement.**				
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	220	65-70	IMA-Being phased out.		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	218	90-95			
	1	Multifunction Aircraft Ground Support System (MAGSS)	211	15-20			
	322	MagneStrap	19	15-20			
	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	19	15-20			
	186	Chemical Gas (Fuel-Rich, Combined Cycle) Turbine System	0	0-0			
227	**6**	**-95 Start Cart**	**Has non-metallic gas tank. Experiences leaking problems during deployment. Replacements are coming in.**				
868	**(6)**	**-95 Start Cart**	**Polymer fuel tank design problem. Swelling of plastic tank causes unusable fuel (135 gal tank, can use only 85 gal).**				
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	220	65-70	CER-Use steel tank.		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	218	90-95			

ID:	S.F.			Score:	Risk/Cost:	Priority: 1	2	3
	1	Multifunction Aircraft Ground Support System (MAGSS)		211	15-20			
	158	Super Lightweight Fuel Tank		6	50-55			
243	6	**MD-4 Generator**	**Unit has a history of shooting sparks and fires (safety).**					
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		220	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		218	90-95	R		
	1	Multifunction Aircraft Ground Support System (MAGSS)		211	15-20			
	302	Split-Cycle Technology Engine		57	90-95		R	
	136	High Efficiency Propulsion System		50	75-80			
	34	Hybrid Gas/Powder Fire Extinguishing Agent (Halon-Free)		39	0-5			
	186	Chemical Gas (Fuel-Rich, Combined Cycle) Turbine System		0	0-0			
251	6	**-10 Air Conditioner**	**Weight on the towbar is too heavy. Difficult to hook unit up to tow tractor**					
305	(6)	**-10 Air Conditioner**	**-10D carts need to be balanced, too heavy in front.**					
306	(6)	**-10 Air Conditioner**	**-10D model tow bar is too heavy - move axle or make it four (4) wheels.**					
323	(6)	**-10 Air Conditioner**	**A/M32D-10 towbar is hard to use to put the wheel down.**					
910	(6)	**-10 Air Conditioner**	**Tow bar very unstable, needs 4 wheels - Female crew chief was pinned (arm caught) down for approx one hour out in the flight line (2nd shift).**					
1281	(6)	**-10 Air Conditioner**	**Balance of unit is no good. Would like to see four wheels and a retractable towbar.**					
	247	High Temperature Electronics (Up to 535 Deg C)		276	90-95		CER-Rework	
	212	Liquid Flow-Through Cooling for Power Supplies		276	90-95		C.G.	or 4 wheels
	360	Immersion Phase-Change Cooling for Aircraft		276	90-95			
	279	High Performance Heat-Absorbing Material for Liquids or Solid Materials		276	90-95			
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		190	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		159	90-95			
	300	Portable Environmental Control System (PECS) for Air Cooling & Heating		159	0-5	P		
	1	Multifunction Aircraft Ground Support System (MAGSS)		151	0-5			R
259	6	**-85 Generator Set (GPGS)**	**Difficult to position (very heavy).**					
267	(6)	**-85 Generator Set (GPGS)**	**-85 and -19 are tied together and hard to move.**					
273	(6)	**-85 Generator Set (GPGS)**	**Also mentioned, GPG being non-maneuverable and too heavy.**					
926	(6)	**-85 Generator Set (GPGS)**	**Difficult to move due to weight (7K lbs)**					
929	(6)	**-85 Generator Set (GPGS)**	**AGE truck, GPG bending hook side ways because of mass (similar to train effect)**					
931	(6)	**-85 Generator Set (GPGS)**	**Cumbersome when checking JFS on 30 jets, approx 2.5 hrs**					
933	(6)	**-85 Generator Set (GPGS)**	**Hard to maneuver, especially when AGE driver puts unit on wrong side of jet (power cord too short)**					
937	(6)	**-85 Generator Set (GPGS)**	**Fuel troops have to move unit bodily to fuel hangar, due to 50' stayout area - very exhausting**					
1320	(6)	**-85 Generator Set (GPGS)**	**Hooks on tow vehicles get damaged while towing this tandem. Too much slop.**					
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		220	65-70		R	

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
280	Rigid-Rod Polymer Plastics for Structural Metal Replacements		57	30-40	R		
202	BFGoodrich's TempRite Low-Combustibility Thermoplastics		57	30-40	R		
36	Advanced Composite (Thermoplastic) Repair for Acft Thermoset Material		57	30-40	R		
306	Composite Vehicle Structure		57	30-40	R		
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)		57	30-40	R		
198	Antimony Oxide Flame Retardant for Composites and Synthetic Fabrics		57	30-40	R		
337	Thermoforming for Fabricating Lightweight Structural Composite Materials		57	30-40	R		
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts		57	30-40	R		
358	Thermoplastic Repairs By Bonding With Induction Heating		57	30-40	R		
188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials		57	30-40	R		
268	Composite Repair Technology for Metallic Aircraft Structures		0	0-0			
70	Australian Fatigue Patching Technology for C-141 StarLifter		0	0-0			
272	**6**	**-85 Generator Set (GPGS)**	**GPG has air and power - if air quits you need to disconnect everything and then get a new GPG. If functions were separate - R&R would be easier.**				
356	Multiple Integrated Power Unit (MIPU) For Aircraft		220	65-70	No real solution.		
278	**6**	**-85 Generator Set (GPGS)**	**Fuel tank filler neck is pressed in and doesn't seal right - causes gas leaks.**				
356	Multiple Integrated Power Unit (MIPU) For Aircraft		220	65-70	CER-Better seal		
216	Self-Sealing Fasteners for Anti-Leak Requirements		43	0-5		IMA-Safety	
158	Super Lightweight Fuel Tank		6	50-55			
331	**6**	**MJ2 Mule**	**Maneuverability: most difficult to position; not self propelled, usually requires three people to move; hard to turn.**				
1002	**(6)**	**MJ2 Mule**	**Hoses not long enough to hookup systems A & B at jet, must maneuver (cumbersome) unit in place**				
1	Multifunction Aircraft Ground Support System (MAGSS)		209	25-30		R	
298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		209	90-95		R	
299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical		63	10-15		R	
44	Low Cost Composite Advances for Aircraft Structures (Graphlite)		21	30-40	CER-Self propelled retrofit		
280	Rigid-Rod Polymer Plastics for Structural Metal Replacements		21	30-40			
35	Advanced Resin Transfer Molding for Complex, Low Cost Aircraft Parts		21	30-40			
306	Composite Vehicle Structure		21	30-40			
188	New Fiberglass Polymer Composite Using Lower-Cost Raw Materials		21	30-40			
331	Hydraulic-Fluid Hose		0	0-0			
332	**6**	**MJ2 Mule**	**Messy to operate.**				

ID:	S.F.			Score:	Risk/Cost:	Priority: 1	2	3
	1	Multifunction Aircraft Ground Support System (MAGSS)		209	25-30	IMA		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		209	90-95			
	299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical		63	10-15			
379	**6**	**LOX Cart**	**New ones come up so fast they can expend blow out disk.**					
	357	Integrated OBOGS / OBIGGS Module for Aircraft		179	25-30	IMA-Training.		
423	**6**	**MC-1A Compressor**	**Compressor oil collects moisture in humid climates.**					
1077	**(6)**	**MC-1A Compressor**	**Moisture gets in the oil.....traps don't get it all. May be due to the dehydrator being located at the end of the system.**					
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		168	90-95	CER-Proper filter or		
	1	Multifunction Aircraft Ground Support System (MAGSS)		160	20-25	relocate.		
	305	Compressed-Air Filters by IMI Norgren Inc., Littleton, Colo.		0	0-0			
	314	Filter/Regulator/Lubricator (FRL) Systems		0	0-0			
492	**6**	**Batteries**	**Problem with replacing battery cells; each manufacture has it's own part number, and even though cells are compatible, they are restricted to part numbers by tech orders; can't use a SAF with a Marathon for example.**					
1376	**(6)**	**Batteries**	**Can't use SAF battery cells with Marathon cells even though they are exactly the same. They are each listed as suitable subs but can't mix vendor types.**					
1379	**(6)**	**Batteries**	**Don't replace Optima gel cells...send whole battery back. Also, don't mix SAF and Marathon cells.**					
	238	All-Plastic, Solid State Battery		121	70-80		R	
	364	Two-Year Batteries for Aircraft		121	70-80		R	
	155	High Reliability Maintenance-Free Battery		121	70-80		R	
	133	All-Plastic Battery		121	70-80		R	
	78	Lithium Solid Polymer Electrolyte Batteries		121	70-80		R	
	346	Low Maintenance Battery System for Aircraft		121	70-80		R	
	27	Reduced Maintenance Batteries		121	70-80		R	
	233	Solar Power to Extend Battery Life (Solargizers)		121	15-20		R	
	175	Battery Checker and Log Device		39	15-20	IMA		
	118	Advanced Lead Acid Batteries		0	0-0			
939	**6**	**-85 Generator Set (GPGS)**	**Can't reset CB - must call AGE to reset popped CB, mostly due to wrong sequence of switches.**					
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		220	65-70	CER-Proper onboard		
	330	Circuit Breaker Switch Panels		22	0-5	instructions.		
944	**6**	**-85 Generator Set (GPGS)**	**Fuel shutoff valve leaks frequently - (3) failures week of 5/17/96.**					
1299	**(6)**	**-85 Generator Set (GPGS)**	**Fuel shutoff valves have leak problems (approximately three times per month).**					
	356	Multiple Integrated Power Unit (MIPU) For Aircraft		220	65-70	CER-Better valve.		
947	**6**	**MC-2A Compressor**	**New diesel engines, chronic rocker arm wear.**					

ID:	S.F.			Score:	Risk/Cost:	Priority: 1	2	3
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		168	90-95	IMA-Supplier fault analysis.		
	1	Multifunction Aircraft Ground Support System (MAGSS)		160	20-25			
	299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical		71	10-15			
	302	Split-Cycle Technology Engine		53	75-80			R
	136	High Efficiency Propulsion System		53	75-80			R
	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet		48	50-60			
	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment		24	15-20		R	
	322	MagneStrap		24	15-20		R	
967	**6**	**MJ-1 Jammer**	**Hyd table tilts (uncommanded) with significant amount weight - safety problem can catch limbs between structure - investigation reveals AGE maintainers don't put enough weight when testing hyd table.**					
1359	**(6)**	**MJ-1 Jammer**	**Some of the jammers have bad tilt controls. With significant weight on the table, can sometimes tilt forward on its own. May hit pylon or people.**					
	297	RAZ and miniRAZ Munitions Handling Trolleys		252	0-5		P	
	152	Electrohydrostatic Actuation (EHA) System for Primary Flight Controls		197	25-30			R
	40	Rare-Earth Magnet Direct Drive Servovalves (DDV), Electrically Controlled		197	25-30			R
	353	Built-In Cable Load Boxes/Drums for Aircraft		46	40-45	IMA		
	87	Trapeze Launcher Actuator Assembly for the F-22 Next Generation Fighter		46	40-45			
	41	High Pressure Miniature Hydraulic Pumps (Fixed or Variable)		37	40-45			
	329	Powertrain Electronics		0	0-0			
977	**6**	**Liquid Nitrogen Cart**	**LN2 cart - Purging causes accumulation of water & ice, have to wait 2 days for thawing - Also, have to remove pumps to drain water - Purging unit may be culprit (Zwick-83).**					
	22	Self-Generating Nitrogen Through Hollow Fiber Membrane Technology		143	25-40		P	
	1	Multifunction Aircraft Ground Support System (MAGSS)		38	0-5	IMA-May be procedural.		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment		18	90-95			
991	**6**	**LOX Cart**	**LOX cart - Purging causes accumulation of water & ice, have to wait 2 days for thawing - Also, have to remove pumps to drain water - Purging unit may be culprit (Zwick-83).**					
	357	Integrated OBOGS / OBIGGS Module for Aircraft		179	25-30	IMA	R	
1045	**6**	**Universal Fuel Tank Certifier**	**Presently, one unit operating & the other down for battery box failure - they are using the down units for cannibalization, because battery box redesign is too expensive & ordered parts have a long lead time.**					
233	**(6)**	**Universal Fuel Tank Certifier**	**On order for 3 years. Reliability is poor, but does a good job when it is up. Need a good means to troubleshoot external fuel tanks.**					
624	**(6)**	**Universal Fuel Tank Certifier**	**Parts are hard to get and expensive.**					
626	**(6)**	**Universal Fuel Tank Certifier**	**Universal external fuel tanks certifier - they are totally unhappy with it.**					
627	**(6)**	**Universal Fuel Tank Certifier**	**Battery box is a problem and they are losing circuit cards due to stray voltages; equipment is useless until repaired. (Fix is going on at Kelly).**					
1136	**(6)**	**Universal Fuel Tank Certifier**	**Worst piece in fuel shop. Battery box problems (Fairchild) have yet to be resolved (circuit cards and stray voltage).**					
1356	**(6)**	**Universal Fuel Tank Certifier**	**Can't get parts. Battery box is number one problem.**					

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
	330	Circuit Breaker Switch Panels	21	0-5	IMA		
1052	6	**Eagle (85/86Ls) (Bobtail)** **Two engine fires due to battery cables**					
	21	U-Shaped Tow Vehicle	64	25-30	CER	R	
	223	Douglas-Kalmer TBL-280 Towbarless Aircraft Tug	64	25-30		R	
	294	Electrically-Powered Aircraft Towing Mechanism	60	25-30		R	
	17	Modular Tow Tractor	60	25-30		R	
	309	Electric Vehicles	46	40-45		R	
	16	Mercury 800 Tow Tractor	41	15-20		R	
1155	6	**-86 Generator Set** **Cork type seals that are used for items on the fuel tank tend to leak after a while. This is a HAZMAT concern.**					
	282	Whisper Power Ground Power Unit From Hobart	276	10-15			
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	220	65-70			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	218	90-95			
	1	Multifunction Aircraft Ground Support System (MAGSS)	211	15-20			
	334	Oil-Resistant Silicone	58	0-5	R		
	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	58	0-5	R		
	216	Self-Sealing Fasteners for Anti-Leak Requirements	43	0-5			
	158	Super Lightweight Fuel Tank	6	50-55			
1159	6	**NF-2D Floodlight Set** **Believe Rugerini engine is being overworked (running at 3000 rpm, should run approx. 1800 rpm) causing valve to drop out putting hole in piston. Can't get engines any longer...takes over 3 months.**					
192	(6)	**NF-2D Floodlight Set** **Believe engine was overrated for the intended load application. Not running at right speed to work it and loads up. Engine would disintegrate if run at any higher speed.**					
1031	(6)	**NF-2D Floodlight Set** **Ruggerini diesel engine, 3 of the 7 engines received last year have failed.**					
	1	Multifunction Aircraft Ground Support System (MAGSS)	171	0-5	Continue engine		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	171	0-5	replacement.		
	243	Computerized System to Track Limited-Life, On-Condition Components	64	15-20			
	302	Split-Cycle Technology Engine	44	90-95			
	136	High Efficiency Propulsion System	36	75-80			
	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	34	15-20			
	322	MagneStrap	34	15-20			
	178	Long-Life Solid State Arrays for DC Power Generation	3	50-65			
	168	Concrete Solar Cells as a DC Power Source at Remote Locations	3	50-65			
1161	6	**NF-2D Floodlight Set** **Rear main oil seal blows on engine. Either replace seal or replace entire engine.**					

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
	1	Multifunction Aircraft Ground Support System (MAGSS)	171	0-5	Continue engine		
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	171	0-5	replacement.		
	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	34	15-20			
	322	MagneStrap	34	15-20			
	334	Oil-Resistant Silicone	32	0-5			
	285	Variseal O-Ring Substitutes with Turcon Engineered-Polymer Compounds	32	0-5			
	168	Concrete Solar Cells as a DC Power Source at Remote Locations	3	50-65			
	178	Long-Life Solid State Arrays for DC Power Generation	3	50-65			
1170	**6**	**MC-1A Compressor** **Fuel lines on top of engine area have a tendency to leak due to cracks caused by excessive vibration. Other parts have cracked and fallen off. Engine is good otherwise.**					
	302	Split-Cycle Technology Engine	53	75-80	CER-Isolate cause.		
	136	High Efficiency Propulsion System	53	75-80			
	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet	48	50-60			
	317	Lighter Cast-Iron Engine Blocks	6	35-40			
1171	**6**	**MC-7 Compressor** **Fuel lines on top of engine area have a tendency to leak due to cracks caused by excessive vibration. Other parts have cracked and fallen off. Engine is good otherwise.**					
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	168	90-95	CER-Relocate lines		
	1	Multifunction Aircraft Ground Support System (MAGSS)	160	20-25	or isolate cause.		
	302	Split-Cycle Technology Engine	53	75-80			
	136	High Efficiency Propulsion System	53	75-80			
	43	Highest-Strength Steel Alloy with Stress Cracking Resistance (AerMet	48	50-60			
	159	New Molybdenum Disulfide Lubricant for Ground Support Equipment	24	15-20			
	322	MagneStrap	24	15-20			
	317	Lighter Cast-Iron Engine Blocks	6	35-40			
1227	**6**	**-85 Generator Set (GPGS)** **Hate -85s for ICTs. They take too long to set up/get ready. There is already too much going on in a rush.**					
	356	Multiple Integrated Power Unit (MIPU) For Aircraft	220	65-70	No Recommendation.		
1258	**6**	**MJ-1 Jammer** **If fuel tank is greater than 3/4 full fuel leaks from cap due to slosh.**					
	297	RAZ and miniRAZ Munitions Handling Trolleys	252	0-5		R	
	309	Electric Vehicles	195	40-45	CER-Better sealing cap.		
	87	Trapeze Launcher Actuator Assembly for the F-22 Next Generation Fighter	46	40-45			
	353	Built-In Cable Load Boxes/Drums for Aircraft	46	40-45			

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
1289	**6**	**MJ-1 Jammer** **Float bowl always leaks and is not needed. Screw-on canister would be better.**					
	297	RAZ and miniRAZ Munitions Handling Trolleys	252	0-5	CER	R	
	309	Electric Vehicles	195	40-45			
	353	Built-In Cable Load Boxes/Drums for Aircraft	46	40-45			
	87	Trapeze Launcher Actuator Assembly for the F-22 Next Generation Fighter	46	40-45			
1309	**6**	**MC-2A Compressor Nine out of ten of the bypass oil cooler electric fan temperature sensor are bad.**					
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	168	90-95	IMA-Supplier fault analysis.		
	1	Multifunction Aircraft Ground Support System (MAGSS)	160	20-25			
	299	Multifunction Unit for Hydraulics, Compressed Air & DC Electrical	71	10-15			
	302	Split-Cycle Technology Engine	53	75-80			
	136	High Efficiency Propulsion System	53	75-80			
1337	**6**	**AIS** **Many of the cables are way too large (128 pin). Should be broken up into 2 or 3 cables. Can't get removal tool to work properly.**					
	340	Gold DotTM Technology for Oxide-Free Electrical Contacts	50	50-55	R		
	308	Improved Fiber-Optic Connectors	0	0-0			
1380	**6**	**Gun Fire Test Set** **If ground is lost on the P-1 fire head, user gets severely shocked. The wire is on the outside (piggy backed) and tends to break a lot.**					
771	**(6)**	**Gun Fire Test Set** **F-16 tester has a ground in back of P1. If it breaks and power is applied, it will knock a person off the aircraft.**					
	262	Portable Computer Diagnostic System for F-16 Flightline Maintenance	133	45-50	CER	R	
1405	**6**	**SE in General** **Supportability (Engine Induced): Numerous instances of hard starting, cold weather starting, post-ignition on shutdown, wet stacking, vapor lock, glow plug breakdown, low cranking power, battery failures on hot days.**					
	253	Electrically Heated Fluid Reservoir Heater	18	0-5	R		
	33	Thermostatically-Controlled Resistive Heaters	18	0-5	R		
	278	Patented Surface Hardening Process (Nobleizing) for Valves	16	15-20			
1408	**6**	**SE in General** **Supportability (Procurement Induced): Numerous instances of too many SE models providing duplicate support functions, lack of commonality among parts, difficult procurement of parts , ill-fitting parts, TO errors for parts.**					
	1	Multifunction Aircraft Ground Support System (MAGSS)	108	20-25			
	298	Hepp Vapor Engine for a Family of Multifunction Support Equipment	106	90-95			
	235	Focused Logistics (Joint Vision 2010)	88	50-55	R		
	237	Joint Computer Aided Acquisition and Logistics System (JCALS)	88	50-55	R		
	210	Streamlined Smart Procurement System by Intelligent Agent Software	57	20-30		R	
	224	Windows-Based Maintenance Budgeting Software	48	5-10			R

ID:	S.F.		Score:	Risk/Cost:	Priority: 1	2	3
290	Strategic Sourcing for Vehicle Maintenance		0	0-0			
1410	**6**	**SE in General**					
		Safety (Engine Induced): Numerous instances of SE shooting fire from exhaust area, ignition fires, SE sets itself afire, leaking exhaust, excessively high noise levels from turbine engines, back injuries from pushing or lifting.					
86	Active Noise Reduction (ANR) Headsets for Armored Vehicle Operators		18	15-20	R		
96	Noise Canceling Headsets (HMEC45-45KA/CA)		18	15-20	R		

Programmatic Lessons Learned

As in any endeavor, reflection on past work often brings insight into the problems and inefficiencies encountered and how they might be avoided in the future. The following observations and lessons learned were made during and after the performance of the SEEIT contract, and are summarized below in no particular order.

1) Field Visits: Collection of the field problems was the foundation of the entire SEEIT SOW. The value of the technology solutions depends on the accuracy of the problem documentation. Large interview groups (10-15) tended to be a problem, as the information flow was excessive. As a result, note taking became fragmented, and follow-up questions seemed to stifle the flow of information. Each individual wanted to talk about his problem first, but became reticent if made to wait. After clearing up details of a particular problem, the group often needed jump starting to bring forth a new problem. In doing so, there was always the perception that certain "problems got away" and weren't resurfaced for us.

Solution: Smaller groups (5-8) would allow better communication. For us, tape recording each of the group meetings proved to be the saving grace, although there were times that too many talkers made the conversation hard to transcribe.

2) Field Visits: Five field visits were conducted for Task 1. This number of bases seemed to be about right, however, the length of the visit felt too short. Each base was scheduled for 5 days, but team travel arrangements and on-base interview schedules made the actual "talking time" something less than 4 days. The perception was that the time invested in establishing a working dialogue with each interview group did not have a full payoff.

Solution: Group interviews had their value. It permitted communication to a larger number of people all at one time, particularly to convey the reason for our visit, our level of expertise on the subject matter, and our interest in their problems. Their response to us was always positive and enthusiastic. Perhaps extending the base visit an additional 2 or 3 days would have permitted individual follow-up with selected people who had more to tell us. The SEEIT team had the feeling that we missed 10 percent of what we were told, and there was 20 percent they didn't tell us about because of the time constraints.

3) Field Visits: There were no new problems with SE. All of the major and many minor problems had been documented before through AF channels and were well known by the aircraft maintenance community, regardless of which base was visited. Yet, these problems continued to persist for many years. We began to realize that not all problems needed a technology solution.

Solution: We learned to listen carefully to the troops when they explained their problems, because they usually told you at some point what the solution should be. Sometimes it was simply a training deficiency or user abuse, and they said so. The troops are the experts on the equipment and have had years of experience using it, maintaining it and repairing it. In many

instances, they had thought about which solutions were the most cost efficient. It was rare to hear a recommendation for wholesale replacement of a piece of equipment unless it was obviously unsupportable due to unavailability of parts. We listened and we learned from it. From this perspective, they made it much easier to document solutions.

4) Field Visits: For the most part, the interview groups had no advance notice of our arrival or the reason for our visit. Before visiting a base, we mailed a sample interview questionnaire to their organization to give them a feeling for the type of information we were seeking. Their pressing work schedule of launching sorties undoubtedly reduced any preparation time.

Solution: Perhaps distributing the sample interview questionnaire on the first day of our base visits, along with a one-hour introduction would have been satisfactory. Then a follow-on interview scheduled a day or two later would have allowed the troops more time to prepare their responses. This might have caught that nagging 20 percent we felt we missed by concluding the base visits too early. Meeting twice with each group may have thrown the visits beyond our arbitrary five-day limit per base, but it would have provided more time for the interviewees to think.

5) Study Structure: The intent of Task 2 was to perform a technology survey to find candidate solutions to the problems and deficiencies documented from Task 1. The resultant candidates included commercial products, materials, processes, software, etc., as well as advanced technologies for military aircraft. The Task 2 survey documented 380 candidates and serves as a nice, larger-than-expected compendium of technologies, both near and far term. However, nearly half of the field problems are design related and could not be solved by new technologies. How could we have done better?

Solution: Discovering what you don't know can be as valuable as finding the "spot-on" solutions. If the study were structured to provide point design solutions with engineering drawings, there would have been only enough time to address one-tenth of the problems. The study was meant to capture a broad spectrum of available solutions, which was undoubtedly the team's focus. Nonetheless, the decision trade-off of having a large technology database versus a lesser amount of point design solutions was necessary due to the scope and funding level of the contract.

6) Study Structure: The SEEIT program schedule included an adequate amount of manhours for database development, but it was within a relatively short period of calendar time. This proved to be unsatisfactory and required rescheduling. We learned that a dynamic database program with any type of sophistication must evolve and grow with the program.

Solution: Spreading out the manhours for database development was not a major problem, but it did reflect our inexperience with the Microsoft Access program. It has proven to be better than our original expectations, and was a perfect choice to document the SEEIT study findings, thanks to the guidance from our resident database experts. We believe the future SEEIT database users will find this to be true for them too.

7) We feel the SEEIT database is a positive step forward in documenting and eventually solving some of the larger problems with flightline SE. It has the potential to serve as the collective data source needed by all the other DoD agencies to solve these problems. The database, however, is only a start, and needs further contributions from other people in order for it to grow and become a more useful tool.

Solution: The projected utilization, and therefore ultimate value, of the SEEIT database remains unclear. We never had the opportunity to interface with the many agencies involved with SE modification, improvement, and procurement, which may have ensured a larger acceptance of the database. Nonetheless, the SEEIT database remains as a very flexible and easily modified program which can accommodate the needs and desires of any user agency. Ultimately, we hope the SEEIT study findings have the potential to convince other agencies of the future research areas needed to improve flightline SE.

Force Deployment Package (LOGFOR)

24 Jun 97

Quantifying the F-16C/D Footprint

Aviation UTC 3FKM30 (Oct 95)
F-16C/D with LANTIRN
Plus Tank Build-Up UTC HFBZP0
388th Ftr Wg (ACC), Hill AFB, UT

Appendix 7 18 PAA Independent Sqn

Inc. No.													
	Generator Set, A/M32A-60A	1	1		3	3	1	9	3,120	123	62	68	12.75
	C-10 Air Conditioner	1	1		3	3	1	9	1,380	108	71	69	11.25
0031 4100	MJ-2A Hyd Test Stand-Mule				1	1		2	6,690	144	72	79	3.30
	MC-2A Compressor-LowPac				2	2		4	880	87	47	40	4.00
4070	MC-1A Compressor-HighPac					1		1	1,980	88	67	60	1.00
4098	MC-7A Compressor					1		1	2,885	128	72	51	1.50
	MB-4 Acft Tow Tractor				1	2		3	12,155	191	87	94	6.50
	MD-1 Towbar	1	1		1			3	500	297	58	32	3.40
0012 4084	B-4 Stand w/ Filler Bleeder				1	1		2	920	117	53	78	2.70
4012 4014	B-4 Stand w/ C-1 Stand					2		2	760	117	56	85	2.70
0085	B-1 Stand w/ C-1 Stand				1			1	1,320	190	61	85	2.20
	MJ-1 Bomblift w/ Shoring			1	4	1		6	3,870	148	54	42	10.10
	MJ-4 Bomblift w/ Shoring				1	2		3	6,875	175	69	42	6.00
	NF-2 LiteAll Cart				3	2	4	9	2,280	108	68	67	11.10
	Nitrogen Cart, Liquid	1	1		1			3	3,400	126	60	55	4.30
2006	Nitrogen Cart, Gaseous		1					1	1,460	114	64	44	1.30
0064 4054	LOX Cart/Vent Kit				1	1		2	1,035	89	39	38	2.10
4111 4114	MEP 105 Generator					2		2	5,200	104	68	69	2.40
0086	Cabin Pressure Tester				1			1	2,840	105	60	57	1.20
0062 0063	Tank Dolly w/ Ladders - 6 Ea				2			2	1,960	119	79	74	2.70
	Tank Loader w/ Lifting Dolly				2	2	2	6	945	169	52	49	11.60
	TOTALS	4	5	1	28	26	8	72		8..0 C-141B Airlifters			~104.10

Force Deployment Package (LOGFOR)

24 Jun 97

Quantifying the F-16C/D Footprint

Aviation UTC 3FKM30 (Oct 95)
F-16C/D with LANTIRN
Plus Tank Build-Up UTC HFBZP0
388th Ftr Wg (ACC), Hill AFB, UT

Appendix 7

18 PAA Independent Sqn

Inc. No.													
5152	Floor Crane, Portable						1	1	5,125	210	66	56	2.50
3003 4062	Trailer, 3000, Stacked-2 Ea.			1		1		2	3,850	191	66	82	4.40
	Trailer, 3000 w/ Engine			1	1	2		4	5,535	190	60	82	8.75
0081 5150	Decon Apparatus - Wheeled				1		1	2	2,440	138	51	57	3.20
0070	Sweeper				1			1	595	89	82	23	1.10
	H-1 Heater, Portable				1		2	3	850	100	53	47	1.75
4091	MHU-141 Trailer, Stacked					1		1	6,795	134	90	97	1.50
	F2A Trailer w/ Lnchrs/TERs				3			3	2,890	138	72	62	4.75
0005	H-70 Trailer, Stacked-2 Ea.				1			1	3,650	128	74	75	1.50
0900	Pallet, Tank Buildup (M2)				1			1	3,760	88	108	76	1.00
0901	Pallet, Tank Buildup (M2)				1			1	1,565	88	108	44	1.00
4109	Pallet Train of 3 -Lantirn Shop					1		1	11,987	266	108	99	3.00
4110	Pallet Train of 3 -Lantirn Shop					1		1	19,222	266	108	99	3.00
0006	Trailer, Fab Flt - Haz Bin				1			1	12,780	204	112	104	2.40
0096	Trailer, Maint Flt - Whl Dolly				1			1	12,368	204	110	104	0.30
	H-70 Casket (Hydrazine)			1	1	1		3	180	51	18	23	0.75
1002	Pallet, Fltline w/ MRSP Bin	1						1	6,240	88	108	89	1.00
2002	Pallet, Fltline w/ MRSP Bin		1					1	4,800	88	108	90	1.00
0010	Pallet, Fltline w/ MRSP Bin				1			1	4,400	88	108	90	1.00
0011	Pallet, Fltline w/ Mod Drawers				1			1	5,219	88	108	80	1.00
	TOTALS	1	1	3	15	7	4	31		(3.6 C-141B Airlifters)			~46.55

Force Deployment Package (LOGFOR)

24 Jun 97

Quantifying the F-16C/D Footprint

Aviation UTC 3FKM30 (Oct 95)
F-16C/D with LANTIRN
Plus Tank Build-Up UTC HFBZP0
388th Ftr Wg (ACC), Hill AFB, UT

Appendix 7 18 PAA Independent Sqn

Inc. No.													
0039	Pallet, Fltline w/ MRSP Bin				1			1	3,348	88	108	90	1.00
0041	Pallet, Fltline w/ MRSP Bin				1			1	2,040	88	108	90	1.00
0061	Pallet, Fltline w/ MRSP Bin				1			1	3,600	88	108	89	1.00
4042	Pallet, Fltline w/ MRSP Bin					1		1	6,774	88	108	89	1.00
4045	Pallet, Fltline w/ MRSP Bin					1		1	4,324	88	108	61	1.00
4058	Pallet, Fltline w/Vidmar Dwrs					1		1	3,910	88	108	88	1.00
4064	Pallet, Fltline w/ MRSP Bin					1		1	4,854	88	108	89	1.00
4066	Pallet, Fltline w/ MRSP Bulk					1		1	3,854	88	108	90	1.00
4073	Pallet, Fltline w/ MRSP Bin					1		1	4,324	88	108	61	1.00
4094	Pallet, Fltline w/ MRSP Bin					1		1	2,365	88	108	89	1.00
5151	Pallet, 10 Ton Tripod Jack						1	1	1,464	88	108	68	1.00
1001	Pallet, Fltline Bins & CTKs	1						1	6,398	88	108	76	1.00
2001	Pallet, Fltline Metal Bins		1					1	6,218	88	108	76	1.00
3001	Pallet, Fltline Metal Bins			1				1	4,529	88	108	90	1.00
0001	Pallet, Fltline Metal Bins				1			1	3,443	88	108	96	1.00
0014	Pallet, Fltline Metal Bins				1			1	4,046	88	108	80	1.00
0015	Pallet, Fltline Metal Bins				1			1	6,059	88	108	70	1.00
0021	Pallet, Wg Pylons/LAU117				1			1	6,080	88	108	75	2.00
0051 4051	Pallet, Wg Wpns Pylons-16Ea				1	1		2	5,712	88	108	75	1.00
0053	Pallet, Armament Flt Mob Bin				1			1	5,505	88	108	92	1.00
	TOTALS	1	1	1	9	8	1	21		(1.6 C-141B Airlifters)			21.00

Force Deployment Package (LOGFOR)

24 Jun 97

Quantifying the F-16C/D Footprint

Aviation UTC 3FKM30 (Oct 95)
F-16C/D with LANTIRN
Plus Tank Build-Up UTC HFBZP0
388th Ftr Wg (ACC), Hill AFB, UT

Appendix 7 18 PAA Independent Sqn

Inc. No.													
0068	Pallet, Fabrication Flt-Testers				1			1	3,120	88	108	85	1.00
0070	Pallet, Intel Flt-Office Eqpt				1			1	3,837	88	108	96	1.00
0090	Pallet, Fltline Eqpt-Metal Bin				1			1	3,962	88	108	96	1.00
0093	Pallet, Life Support-Mob Bin				1			1	5,017	88	108	67	1.00
0094	Pallet, Flt Crews-Office Eqpt				1			1	5,178	88	108	47	1.00
4006	Pallet, Avi Flt-Maint Fix Set					1		1	3,245	88	108	84	1.00
4031	Pallet, AGE Flt-Mob Bin					1		1	3,895	88	108	96	1.00
4032	Pallet, Wpns Racks - 24 Ea.					1		1	1,458	88	108	84	1.00
4076	Pallet, Avi Flt - ASE Assy					1		1	3,280	88	108	76	1.00
4083	Pallet, Avi Flt - Fork Adaptor					1		1	844	88	108	36	1.00
4089	Pallet, Avi Flt - Mobility Bin					1		1	7,190	88	108	76	1.00
4093	Pallet, Avi Flt - ASE Cables					1		1	4,601	88	108	68	1.00
4106	Pallet, Fltline Eqpt - Testers					1		1	4,584	88	108	72	1.00
4108	Pallet, Accessories Flt-M.Bin					1		1	2,389	88	108	54	1.00
4112	Pallet, Avi Flt & Access. Flt					1		1	3,669	88	108	68	1.00
4113	Pallet, Avi Flt - Lantirn Eqpt					1		1	3,414	88	108	54	1.00
4115	Pallet, Avi Flt - Elect Benches					1		1	3,019	88	108	68	1.00
4116	Pallet, Avi Flt - IAIS Units					1		1	5,141	88	108	74	1.00
4117	Pallet, Avi Flt - Mob Bins					1		1	3,094	88	108	68	1.00
5143	Pallet, Fltline ABDR Eqpt						1	1	2,806	88	108	96	1.00
	Pallet, Personnel Baggage	1	1	1	6	6	1	16	2,500	88	108	70	16.00
	TOTALS	1	1	1	11	20	2	36		(2.8 C-141B Airlifters)			36.00

Force Deployment Package (LOGFOR)

24 Jun 97

Summary of the F-16C/D Footprint

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Appendix 7 18 PAA Independent Sqn

Deployment Echelon Page 1	4	5	1	28	26	8	72	205,825	21,445	104.1	8.0
Deployment Echelon Page 2	1	1	3	15	7	4	31	144,986	15,595	46.6	3.6
Deployment Echelon Page 3	1	1	1	9	8	1	21	94,559	9,400	21.0	1.6
Deployment Echelon Page 4	1	1	1	11	20	2	36	113,743	14,218	36.0	2.8
LOGFOR Summary	7	8	6	63	61	15	160	559,113	60,658	207.7	16.0
Command							2				
Chief of Maint							13				
Equipment Maint							46				
Acft Gen Unit							160				
Component Repair							23				
Operations							5				
Unit Airlift Support							3				
Acft Aircrew							25				
Intel Supt Mgmt							5				
Sply WRSK/BLS Mgmt							6				
Flight/Missile Med							3				
MANFOR Summary							291				
TOTALS	(Personnel: 258 Airmen/33 Officers)										